Cocking chromo W. Wo-

THE CURE OF

CATARACT

AND OTHER EYE AFFECTIONS.

THE

MEDICAL AND SURGICAL TREATMENT

OF CERTAIN

DISEASES AFFECTING THE INTERNAL EYE.

BY

JABEZ HOGG,

SURGEON TO THE BLOOMSBURY EYE HOSPITAL;
CONSULTING SURGEON TO THE ROYAL WESTMINSTER OPHTHALMIC HOSPITAL;
OPHTHALMIC SURGEON TO THE ROYAL MASONIC INSTITUTIONS FOR BOYS AND GIRLS;
CONSULTING OPHTHALMIC SURGEON TO THE HOSPITAL FOR DISEASES OF WOMEN AND CHILDREN, VINCENT SQUARE;
FELLOW AND LATE VICE-PRESIDENT OF THE MEDICAL SOCIETY OF LONDON;
FIRST PRESIDENT OF THE MEDICAL MICROSCOPICAL SOCIETY;
HON. FELLOW OF THE ACADEMY OF SCIENCES, PHILADELPHIA; OF THE BELGIAN MICROSCOPICAL SOCIETY, OF THE MEDICO-LEGAL SOCIETY, NEW YORK, ETC.

AUTHOR OF

A MANUAL OF OPHTHALMOSCOPIC SURGERY, BEING A TREATISE ON THE USE OF THE OPHTHALMOSCOPE IN DISEASES OF THE EYE;
PARASITIC DISEASES OF THE SKIN, THE EYE, AND OTHER AFFECTIONS;
IMPAIRMENT OR LOSS OF VISION FROM SPINAL CONCUSSION OR SHOCK;
THE MICROSCOPE, ITS HISTORY, CONSTRUCTION AND APPLICATION;
ELEMENTS OF NATURAL PHILOSOPHY; ETC.

THIRD EDITION—ENLARGED.

LONDON:

BAILLIÈRE, TINDALL, AND COX,

20, KING WILLIAM STREET, STRAND.

1882.

LONDON:
PRINTED BY A. S. MALLETT,
WARDOUR STREET, W.

PREFACE TO THE THIRD EDITION,

AN intimation received from the publisher to the effect that a second edition of your book is quite exhausted, and another called for, must at all times be an acceptable announcement to an author. He will, indeed, receive it as a gratifying indication, so far, of either a success achieved or a want supplied.

In issuing this, a third edition of my *brochure*, "On the Cure of Cataract," it is simply necessary to say that the text has been thoroughly revised and several pages of new matter added. The directions given for employing the ophthalmoscope in the investigation of internal eye disease will, I trust, render it more acceptable to the student and the general practitioner.

1, BEDFORD SQUARE.

November, 1882.

TABLE OF CONTENTS.

Chapter I.

Chapter II.

Chapter III.

Chapter IV.

FRONTISPIECE.

EXPLANATION OF COLOURED PLATE.

Fig. 9.—Internal appearance of a glaucomatous eye, exhibiting considerable excavation of the optic disk.

Fig. 10.—Albuminuric retinitis, an exaggerated form of the disease, showing a number of albuminous deposits, and ending in blindness.

Fig. 11.—Posterior staphyloma, with maceration of the choroidal, pigment coat; patient myopic and a sufferer from spectral phantoms.

Fig. 12.—Posterior staphyloma, with disseminated choroiditis; patient myopic and much troubled with spectral illusions.

CATARACT,

AND OTHER EYE AFFECTIONS.

THEIR MEDICAL AND SURGICAL TREATMENT.

CHAPTER I.

VISION is truly described as the noblest of the special senses; and its extinction is justly regarded as one of the heaviest of human afflictions. Every sense and every faculty seems to flow towards the eye, and to find expression through it to the sensorium.

The formation of images by the organ of vision; the way in which the waves of light impinge upon the nervous tissue of the eye, and there leave behind an impression of external objects, to be conveyed to the sensory organ, the brain, comprises a series of vital and physical actions of a marvellously complicated nature. A recent philosophical writer sums up the various operations associated with seeing as follows:—"Sight may be defined as an aggregation of colour feelings, and muscle feelings, and the objects of sight groups of such feelings, suggesting other feelings in all individuals. All the sensations which go along with the sensation of sight, interpret it, just as language is interpreted by the brain. That is, a sensation calls up a conception, which is made up of an aggregation of

beliefs, and is a link between sensation and action." (*Clifford*). The power of seeing undoubtedly has a definite limit assigned to it, which differs in most individuals, and varies with increasing age, and from functional causes. The act of seeing is partly voluntary, and partly muscular, consequently it is capable of being increased, or rather strengthened, by the judicious exercise, and at will, of a power termed accommodation. The near point of useful sight is fixed, for the normal eye, at about ten inches from the object. It is for this reason that English opticians have taken an arbitrary measurement of ten inches for the length of the body of the microscope. The most distant point of distinct vision is placed where the image of the object falls exactly on the most sensitive spot of the retina, termed the far-point of vision. When the eye is accommodated for viewing a near object, the curvature of the lens is slightly changed, and its front surface approaches somewhat closer to the cornea. The range of the field of vision is computed to be about 160 degrees of the horizontal plane, and 120 degrees in the vertical. The eye is perfectly adjusted for parallel rays of light, but when it has to do with divergent rays it is frequently found unequal to the task of uniting them. The great mobility of the eye-ball, however, almost wholly compensates for this slight defect; and, practically, all rays are parallel which proceed from distant objects, that is from objects at twenty feet and upwards.

Good visual accommodation depends upon three causes: first, changes in the indices of refraction of the media (cornea, lens, &c.); 2nd, displacement of the surface of projection (the retina, analogous to the artificial production of accommodation by the adjustment of the camera obscura); and 3rd, alteration in the forms of the refracting surfaces.

Physicists assure us that the organ of vision, heretofore regarded as the most wonderful instance of creative wisdom, is not perfectly achromatic; that, in fact, it possesses no proper provision for the correction of its own chromatic and spherical aberrations, nor for the correction of the chromatic aberration arising from its defects as an optical instrument, nor that arising from the compound nature of light, the rays of which, it is known, are refracted in different degrees and intensities—a defect slightly exaggerated by defective centering of the refractive surfaces of the internal eye. The want of perfect achromatism is a fact somewhat analogous to that belonging to the flint and crown-glass construction of the lenses of optical instruments. On the other hand, with regard to its spherical aberration—straying away of the rays of light—it is said that the great mobility of the iris corrects this defect. The iris acts somewhat as the diaphragm does in the microscope, shuts off the circumferential rays of light—those rays which, straying away, produce distortion of images in lenses, and increase the circles of dispersion over the retina. Luminous rays on entering the eye are partly absorbed and partly reflected, and on issuing once more follow the same course as they did in the first instance. A certain proportion, however, of each bundle of axial rays, after having undergone refraction, are brought to an accurate focus on points of the retina, and excite a limited number of the outer layer of rods and cones. The sharpness with which the aërial image is seen depends upon the magnitude of the retinal image and the diameter of the visual angle. Other considerations enter into the theory of vision, as that of the situation of the retinal image, etc. By education and experience we become acquainted with the fact that objects are not so well defined under a small visaul

angle, and for viewing minute bodies it is absolutely necessary to resort to artificial means. Withal, to view the infinitely little in all their beauty of form and complexity of design, we require, for the most part, associated with light a difference and intensity of brightness and of colour; for the delicacy of visual perception is found to depend less upon the number of the retinal elements set in motion by the waves of light, than upon the number of elements capable of appreciating and separating the many delicately coloured tints, embraced by the images. (*Hermann.*)

Considering the very great importance and necessity of the organ of vision to human beings, it is not surprising that its diseases should have become, in the early history of medicine, an object of special study. The numerous surgical operations performed upon the eye, from their minuteness, delicacy, and peculiarity, require an amount of dexterity and skill in every way unsurpassed by that of any other department of the healing art—whilst the physiological and pathological changes observed by the aid of the microscope and the ophthalmoscope have raised the treatment of eye diseases from the domain of empiricism to the near approach of a scientific system of medicine. Pathological anatomy applied to most other organs of the body is employed chiefly in displaying lesions, the existence and nature of which are judged of, in a great measure, from what are termed subjective symptoms; in other words, the surgeon relies almost exclusively on the testimony of the patient. In diseases of the eye it is not so, the greater part of the pathological changes form so many objective, positive, symptoms of the disease, and these are read off in the living eye by the aid of the ophthalmoscope. Hence the morbid anatomy of the eye approaches more closely to a *symptomology* (*Wardrop*). The ophthalmoscope

is a mirror designed to reflect light through the pupil, and by means of which we are enabled to detect changes taking place in the tissues of the eye; a method daily becoming more important, not only to the oculist, but to the physician for the diagnosis of diseased conditions of eye and brain. Before the introduction of this instrument, it was not unfrequently a matter of considerable difficulty to decide whether the dioptric media had lost transparency; very often a difference of opinion existed on this single affection, for from no other study, no experience in the diseases of other organs, will the surgeon derive assistance in the determination of cataract; but by the ophthalmoscope, a very slight opacity in the refractive media, lenticular structures of the eye, is readily detected, and the earliest indication of disease can be determined with as much certainty as those affecting the more superficial parts of the body.

The aid of the ophthalmoscope in the diagnosis of eye disease is so important that a short description of the instrument and the method of using it will not be out of place.

MODE OF EXAMINING THE INTERNAL EYE.

In the theory of the ophthalmoscope, the mirror is supposed to be employed only for the purpose of throwing light into the inner chamber of the eye. Practically, however, it is made to subserve another and more important object. The small aperture in its centre allows an observer so to place himself in the axis of the vision of another, that rays of light reflected from the back of the eye of the latter shall pass into his own eye; and thus a view of the interior, nerve, vessels, &c., is obtained. But although this is attainable by the

observer placing his own eye at the somewhat inconvenient distance from the eye observed of not more than an inch or two, such an examination is trying both to the observer and the observed; to the latter, even painful at times, owing to the concentration of the rays of light upon an over-sensitive retina.

Two methods of employing the ophthalmoscope—the *direct* and *indirect*—are in constant use. Both should be employed, as each has its uses and advantages.

Fig. 1.

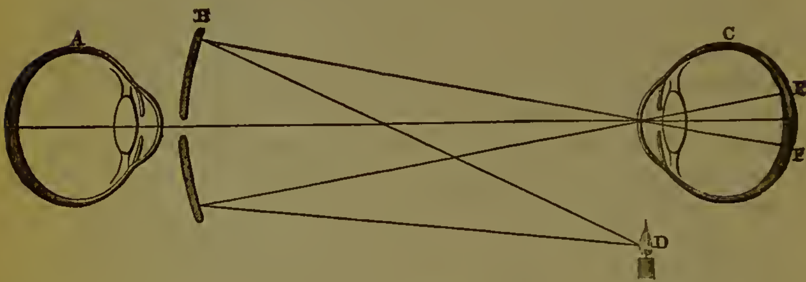


Fig. 1 is intended to illustrate the *direct* method. The ophthalmoscope is supposed to be arranged for normal vision; but the relative distance between the eye of the observed and the observer is, however, not accurately shown in the diagram. A is the eye of an observer, placed behind the central aperture in the mirror, B, which collects the rays of light from a candle or lamp at D, reflecting them into the eye of the patient at C, where they are received on the fundus in circles of dispersion, described between F, F.

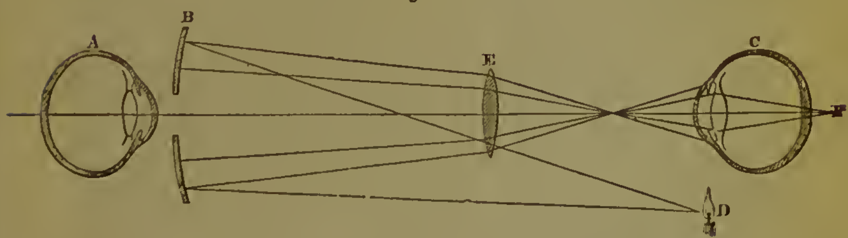
The observer sees a virtual erect image of the fundus, magnified by the reflecting media of the eye. In the myopic, we obtain a general view of the fundus in this way; but, in such a case, it becomes the *indirect* method,

as from the greater elongation of the globe the whole is more or less indistinctly seen, and we require to use a concave lens before a perfectly clear outline can be obtained.

In the *indirect* method of examination, the observer removes the mirror to the ordinary distance of distinct vision, from the eye of the observed, and places before the latter a biconvex lens of about two inches focus. If the returning rays are parallel, or nearly so, and the biconvex lens is held two inches from the eye of the patient, then an inverted aërial image of the fundus will be formed two inches from the lens, or four inches from the patient's pupil, and consequently it will appear so much nearer to the eye of the surgeon. If we wish to increase the size of the image, or give better definition to it, another lens, called an amplifying lens, of greater focal length must be employed behind the mirror, as an eye-glass. This not only increases the apparent magnitude of the image, but enables us to approach nearer to the eye of the patient; in other words, diminishes the distance between the eye of the observer and the observed. This is effected by the author's class or demonstrating ophthalmoscope, *fig.* 4.

The following diagram, *fig.* 2, conveys a tolerably

Fig. 2.

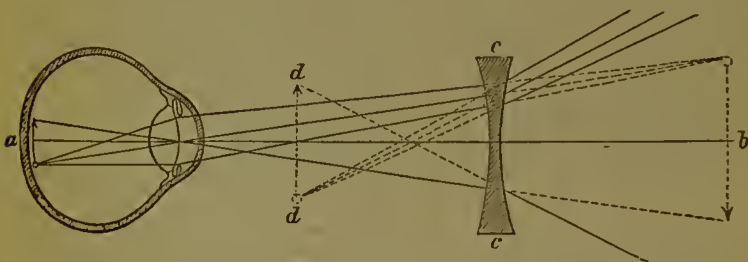


correct idea of the *indirect* method of examination. A is the eye of the observer, B the mirror, and E the

biconvex lens of short focal length. This lens, it will be seen, receives the reflected rays of a candle D, and concentrates them upon the fundus, from which they are returned, and an enlarged inverted image is formed at some point between it and the eye of the surgeon at A. The lens, in this case, concentrating the rays of light from the mirror, adds to its illuminating power and lessens the circles of dispersion ; thus also a larger and clearer view of the back of the eye is obtained. There is a first reflection of the flame from the surface of the cornea, which must be obviated by inclining the mirror more or less obliquely to its surface.

In all cases, the visible area increases in size as we withdraw the biconvex lens from the patient's eye ; in very many cases, it will be found that an eye exposed to the strong light of the mirror has a tendency to fall into

Fig. 3.



a state of adjustment for distant objects, especially so should atropine have been employed to dilate the pupil.

If a biconcave lens is employed, as in *fig.* 3, an enlarged erect virtual image of the retina is seen—an effect due to the dioptric media of the eye in conjunction with the lens, converting the eye into a telescope.

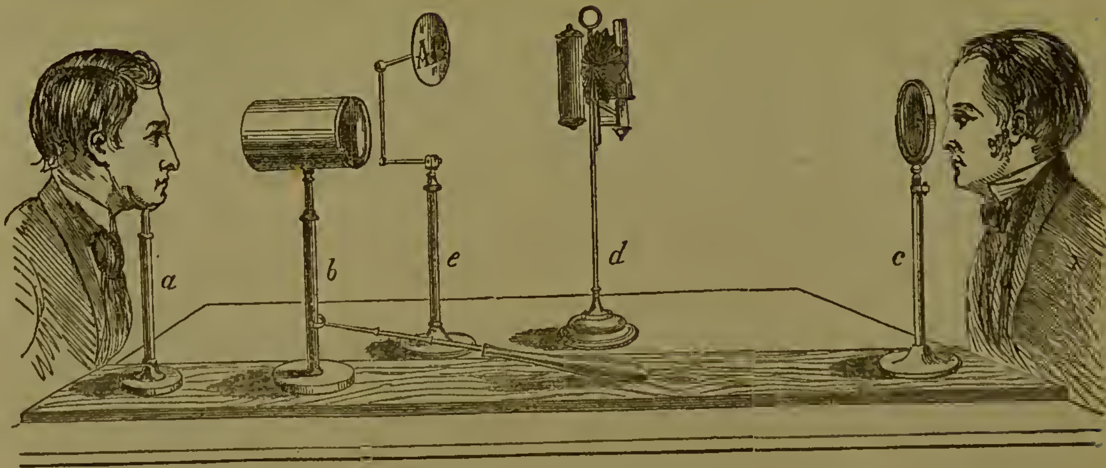
If either the eye of the surgeon or the patient be myopic, then it becomes absolutely necessary to use a

concave lens, to give the requisite degree of parallelism, or divergence to the reflected rays, otherwise a confused, ill-defined, or indistinct image will be the result, and arising from the elongation of the globe of the myopic eye. The concave lens *c c*, should in one case be placed behind, and in the other before the mirror, to produce a good image of the fundus at *d d*.

COMPARISON OF DIRECT AND INDIRECT METHODS.

Finally, when the respective advantages of the direct and indirect methods of examination come to be fairly considered, the superiority of the latter, in most cases, must be admitted; and when once the illusive displacement of the optic nerve has become inoperative, by mental adjustment, then the indirect method enables the observer to get a better idea of the relative position and the proper magnitude of objects; larger portions of the chamber are also brought under observation at the same moment. Details come out with a distinctness and exactness of definition which is not always the case in the direct method of examination. By the direct or erect method, we obtain a view of the back of the eye with the mirror alone, and without having recourse to the biconcave lens; and the optic nerve and vessels are seen under a magnification of ten or fifteen diameters; whereas by the indirect method, the interposition of a convex lens, the magnification obtained is at most only five diameters. The chief value of the biconvex lens is that by its aid a clearer and better image of the several tissues is obtained; the optic nerve is well defined and nearly fills the pupil. In the direct method the concave lens is interposed to correct the too convergent rays of light. The observer, however, at all times and in special cases selects the method in accord

Fig. 4. A CLASS OR DEMONSTRATING OPHTHALMOSCOPE.



a, Concave chin rest, supported on a vertical tube. *b*, Pair of plano-convex lenses, with long horizontal handle fixed to lower part of tube. *c*, Mirror hung in a gimbal by screws. *d*, An Oxford reading-lamp, with screen for protecting the eye. *e*, Moveable disc, with bold letters printed on its face, for fixing and directing the attention of the patient.

with the quality of his own vision, as well as that of his patient, whether normal, myopic, or presbyopic—and as he may desire to obtain a general or limited and well-defined view of the internal eye.

For demonstrating eye diseases to a class of students, an ophthalmoscope constructed and arranged on a somewhat different principle is required. (See *fig.* 4.)

I employ two plano-convex lenses, each 23 centimetres, about 9 inches focus, when combined of 4½ inches focus, with their convex sides turned towards parallel rays, and which reduces their aberrations to about one-fourth of that of a single lens in its best form. By mounting each lens in a separate piece of tubing—one tube being slightly smaller than, and sliding within, the other, for the purpose of accurately adjusting the two—I obtained a sharp, well-defined image of the fundus oculi, far superior to, although not so much magnified as, that obtained by employing a biconvex lens. A reflected image of the mirror, which is sometimes annoying, is got rid of by making the lens nearest the observer turn on its vertical axis, thus giving it a moderate degree of obliquity. An erect magnified image of the back of the eye is seen when the mirror alone is employed; but as this is used at 40 inches from the fundus, it is beyond the range of ordinary vision.

To set up the instrument for use, it is only necessary to bring the centre of the lens and mirror into the horizontal plane with the eye of the patient, and allow a patch of light about the size of the eye to fall upon the cornea. The focus is very nearly correct when a small image of the central opening in the mirror is seen brightly depicted in the spot of light on the eye. The long handle attached to the tube carrying the lenses is used for the purpose of bringing the fundus to

a perfect focal adjustment. The arrangement of the several parts of the instrument is shown in the woodcut, with the relative distances tolerably well preserved. A mirror, of about 18 inches focus, which has the usual central perforation, is hung in a gimbal by screws, and can be turned in any direction. It must be placed about forty inches from the eye under examination. The patient is represented seated at *a*, with his chin firmly supported in a convenient concave rest, the foot of which is secured to the table. The lenses, mirror, and chin-rest are each fitted in upright adjustable draw-tubes, with screw clamps, for fixing them at any required height. The eye of the patient must be turned slightly away from the bright spot of light, and kept directed towards some fixed object. A moveable disk with a bold letter or two printed upon it (represented at *e*) will be found most convenient for the purpose. This will assist, also, in keeping the optic disk in the centre of the field during an examination. The best illumination is obtained by employing an ordinary Oxford reading-lamp, which should be placed at a convenient angular distance within the focus of the mirror of either to the right or left of the observer. A small cardboard screen is affixed to the lamp, and protects the eye from the diffused light emitted by the lamp.

The image obtained by the aid of this instrument is the counterpart of that seen when the hand-ophthalmoscope is used; and the ease with which it can be adjusted and the fundus kept in view is, I consider, an advantage and a great saving of time. A few seconds serve to put the instrument in position, and the merest tyro, equally with the experienced observer, will have no difficulty in using it. No specially darkened room is needed; the ordinary consulting-room, with the

blind drawn down, is all that is necessary for a demonstration.

WHAT IS SEEN WITH THE OPHTHALMOSCOPE.

The ophthalmoscope, it must be remembered, reverses the image of the back of the eye. You see first of all the choroid, which, on account of the fineness of its vessels and its pigmental covering, appears as an almost uniform pink lining of the cavity of the eye. Upon it is spread out the retina; this, however, being transparent, is only to be recognised in normal states by the delicate branches of its vessels. These vessels converge towards a pinkish white, rather oval disk, the optic nerve.

This disk is the point of the entrance of the vessels and of the optic fibres. The true centre of vision lies a little to the outer side of the disk, called the "yellow spot." The central depression in the middle of this spot is called the "fovea centralis." The optic disk is the centre of dispersion from which the optic fibres radiate in a cup-like expansion. The rim of the cup reaches up to the ciliary region, and is called the ora serrata, It is often said that the expansion of the optic fibres forms the retina, but this is not altogether the case. The retina is a structure distinct from the optic nerve, a structure more complex than it, having a distinct system of nutrition. The vessels proper of the retina, the central artery and the central veins of the retina, though they have not much structural continuity with the optic nerve-fibres, are, however, closely associated with them in the orbit. The central artery leaves the ophthalmic artery in the orbit to penetrate the sheath and substance of the optic nerve, and it passes through the sclerotic ring to appear in the optic disk almost at its centre. At the point of the

entrance of this nervo-vascular trunk, the sclerotic coat is denser than at any other part of the eye, and it is pierced by a number of openings which allow the vessels and nerve-fibres to pass through. This circular pierced plate is called the cribriform plate, and its circumference forms an unyielding ring called the sclerotic ring. As it traverses the sclerotic, the nerve bundle shows a slight constriction. The relation of the sclerotic ring to the optic trunk with its nerves and vessels is of considerable importance. There is no cribriform plate in the choroid, but a simple oval opening, which should be exactly the measure of the nerve trunk. Not infrequently, however, it is a trifle larger, and from this cause the brilliant, bluish white sclerotic is often exposed around the disk, giving the appearance of a segmental or circular collar—an abnormal condition of no pathological import, although sometimes it is said to be the commencement of atrophy or excavation. It is, however, occasionally seen much exaggerated, when it is said to be diagnostic of a form of disease termed posterior staphyloma.

The optic nerves take their origin chiefly from certain bodies situated in the brain, termed corpora quadrigemina. These bodies, on grounds of physiology and of pathology, are regarded as the principal, if not the only, centres of vision. Two little tracts or ribbons take their rise in the corpora quadrigemina, cross the crura cerebri, and then detach themselves from the encephalic mass. After this detachment the tracts of the two sides unite to form the chiasma, from which the optic nerves branch off to the eye.

I have so far purposely carried my investigation beyond the fundus, what can be seen with the ophthalmoscope, in order that the relation of the organ of vision to the brain proper may not be lost sight of.

CHAPTER II.

THE DIOPTRIC PARTS OF THE EYE: THE REFRACTIVE MEDIA CONCERNED IN CATARACT.

It is almost unnecessary to attempt to give more than a very brief description of the structures concerned in the disease termed cataract. The dioptric parts liable to become opaque are, the cornea, the aqueous humour, the lens, and the vitreous body. The cornea, in health, is perfectly transparent; in form, it is a segment of a sphere. Its chief function is to bring the pencils of light which flow from any point of an object, by refraction, to corresponding focal points on the retina, without iridescence, and at whatever distance the object may be placed. The cornea is composed of several layers; its posterior layer is bounded by a cellular chamber, or shut sac, filled with aqueous fluid, the walls of which give to it the form of a meniscus lens. Although apparently a structureless membrane, disease or inflammation brings into view a series of vessels; an exudation of pus occurs between its several laminæ, and is followed by opacity or loss of vision. Opacity of the cornea is occasionally confounded with cataract. By the action of certain re-agents on the cornea, the several vessels, nerves, cells, and corpuscles are, under the microscope, brought into view; in a thin section we observe a series of irregular stellate nucleated cells—known as "connective tissue corpuscles"—and a

plexus, or net-work of nerve fibres; both sets being coarsely represented in the accompanying woodcut (*fig.* 5).

The aqueous chamber may be said to be in communication, through tho pupil, with the crystalline body, at which point it divides the eye into an anterior and a

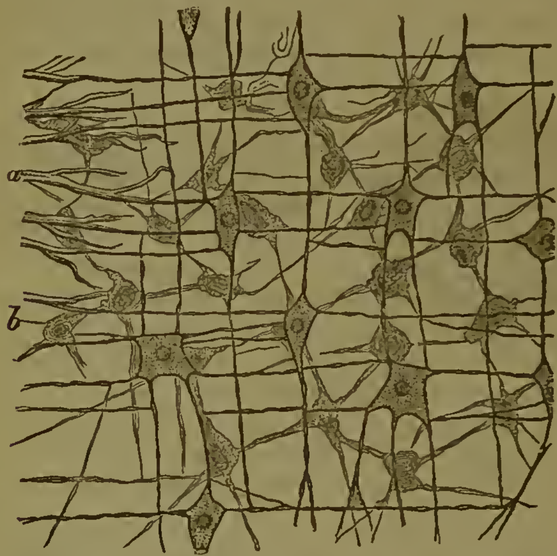


Fig. 5. Nerve and stellate cells of cornea magnified 250 diameters. *a.* Nerve cells. *b.* Connective stellate tissue corpuscles.

posterior chamber. The lens is a mathematically-formed double-convex body, slightly more convex before than behind, and is seven-twentieths of an inch in diameter. It is carefully enclosed in a homogeneous capsule, called the membrane of Decemet, the inner layer of which is separated from the lens substance by a single layer of hexagonal cells. The intimate structure of the lens is lamellated and fibro-tubulus. These

tubules when examined under the microscope, and with high powers, are seen to be slightly serrated or denticulated (*fig.* 6)*, and as they approach towards the centre, they become gradually smaller and denser, and ultimately quite fused into the granular substance. The nourishment of the lens is maintained before birth by a network of vessels (2); at birth these are obliterated, when nutrition becomes extra vascular (as it is termed); by imbibition, its fluid supply being drawn from the ciliary

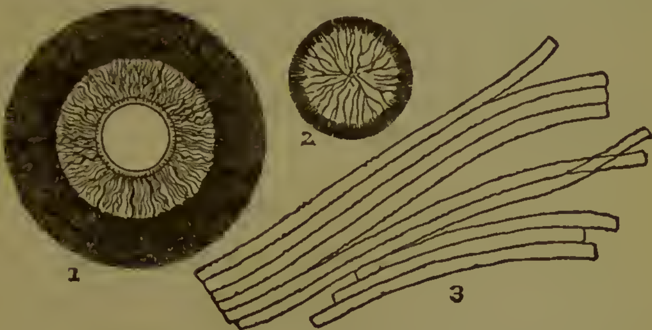


Fig. 6. 1. A slightly enlarged view of the iris and front part of the eye, showing blood supply.
2. The vascular capsule of the lens in utero. 3. Serrated lens fibres.

vessels of the choroid (1). The chemical composition of the lens is protein: albuminous and slightly mixed with crystalline materials, and epidermic tissue A loss of transparency in the fibro-tubules or other lenticular structures constitutes cataractous disease.

The lens is embedded in and derives support from a cellular gelatiniform mass, the vitreous body. This occupies about three-fourths of the globe of the eye, taking the form of a meniscus lens, with its concave

* For a fuller description of the nerve and stellate cells of the cornea, see the author's "*Manual of the Ophthalmoscope.*"

surface turned forwards. The vitreous body has an enveloping membrane, the hyaloid, which blends with the capsule of the crystalline, and assists, together with the suspensory ligament (or Zonule of Zinn), in sustaining the lens in its place.

Opacity of any of the dioptric media described necessarily obstructs rays of light which should be transmitted to, and impressed upon the retina, thus producing partial blindness. When the term cataract is employed, it denotes that the opacity is situated between the vitreous humour and the pupil. The formation of a cataract may occupy months or years; occasionally lenticular opacity is fully developed in a very short space of time.

ÆTIOLOGY OF CATARACT.

The aid of the microscope and of chemistry has been invoked to explain the proximate cause of lenticular opacity, but only with partial success. We know perfectly well that if the nourishment of the lens is ever so slightly changed or deranged, its normal functional mechanism is likely to be interrupted; we also know that a variety of causes outside the chamber of the eye—diseases affecting other and distant organs of the body—will produce cataract. The disease is then said to arise from secondary causes, and the practical deduction to be drawn from a knowledge of this fact is, that a careful inquiry should be instituted into the general health of the patient—the bodily functions, mode of living, &c., carefully looked at—that premature degeneration of structure may if possible be prevented or arrested.

The known results and predisposing causes of cataract are already numerous; but it may well be

questioned whether there are not others, arising out of apparently slight causes, with which we have not yet become acquainted. For instance, in certain parts of the country, and also on the Continent, from the chemical constitution or contamination of the drinking water of the place, a lamentable urinary disease, stone, is produced, and often very prevalent. It is equally true that cataract has been observed to be more common in countries where wine is cheap and abundant, in India where rice is the staple food of the population.

The formation of cataract at or before the middle period of life may generally be traced to secondary causes, is generally indicative of degenerative change, and an early break-down of health. An excess of phosphate of lime is found in the senile cataractous lens; from this circumstance it has been said to arise from protein compounds, the lens becoming coagulated and consolidated by the presence of a free acid. In the congenital form of the disease, it is believed that at some period of fœtal life there has been an arrest of development, while an actual hereditary tendency to cataract is observed in families. I have known cataract affect the third generation in the female branch of a family, altogether missing the male branch, and *vice versa*. A congenital predisposition to the disease has been noticed by most ophthalmic surgeons. Lenticular opacities are common among Turks, from the abuse of opium, and in volcanic countries, Naples and Sicily, probably from a peculiarity of soil or water. It has also been observed that a compulsory use of bread made of diseased flour, "spured rye," or meal containing ergot, induces cataract (*J. Meyer*); in fact a perfectly uncomplicated case is seldom met with (*Mackenzie*). Nevertheless, it would be somewhat hazardous to venture an opinion as to how, when, and where, or in

what organ of the body, the disease has its origin; amongst the remote and predisposing causes, however, of cataract I may enumerate persistent forms of stomach derangement, dyspepsia, kidney affections, stricture, with and without kidney disease; syphilis; diabetes; albuminuria or Bright's disease; heart disease, atheromatous affections of the arteries; rheumatism; gout; particular trades and occupations; mechanical injuries; hereditariness, etc., and all of which will be examined more or less in detail further on. It is, however, the remote and predisposing causes or complications of cataract—those having a constitutional origin—I am particularly anxious to discuss, since they are very likely to mar the success of any attempt to cure the disease by operation. On the other hand, in the early stage of the affection an accurate diagnosis enables the surgeon to direct his therapeutical agents with more hope of success. I am of opinion that with regard to the prognosis of the disease, inconclusive with the probabilities of cure, we are too much in the habit of raising sanguine hopes in the minds of patients affected with cataract, that by a surgical operation their sight may be perfectly restored, not weighing with sufficient consideration the frequency with which other morbid changes in the organ of vision are associated with this disease (*Mackenzie*).

VARIETIES OF CATARACT.

Lenticular opacities have been divided and subdivided, apparently for no better purpose than that of making distinctions. These divisions are purely arbitrary, and founded upon the particular membrane or tissue supposed to be affected. For all practical purposes it is sufficient to speak of a cortical, a nuclear,

a lamellar, with and without striations, and a fluid or soft variety of cataract. Lenticular opacity, after the disease has become manifest, varies in colour and consistency according to the period of life at which it occurs. In the cataract of childhood it is always laminar and stratified, and the whole substance of the lens appears to be of a milk and water colour. In adult life it is nuclear and cortical, or both combined, and is of a whitish colour, or may be nearly colourless; later in life, in some forms of cataract, it becomes much firmer, hard in consistency, and of a yellowish or amber colour, or striated, having radii stretching from the centre towards the circumference; or, as is more generally the case in elderly people, striæ proceeding from the circumference to the centre. Senile cataract undoubtedly arises from degeneration of the fibres of the lens; this to some extent depends upon loss of nutrition or impairment of the nutritive functions. After extraction the lens appears to be less deeply coloured than it was whilst in the eye, and in a few instances it is seen to be so dark in colour that the term "black cataract" has been applied to it. It cannot be doubted that diminished sensibility of the retina is occasionally associated with cataract. The restoration of vision may then depend, first, on the integrity or transparency of the media, and secondly, on the nervous sensibility which regulates the vascular supply; the first giving rise to less accurately defined images on the perceptive layer of the retina, and the second rendering perception and conduction uncertain and imperfect.

Differential diagnosis of cataract has been of considerable importance both to patient and to surgeon; and it should naturally determine the line of action to be taken for the cure of the disease. The methods of

investigating and determining opacities of the dioptric media are two: that by the ophthalmoscope, and that by the convex lens, concentrated light. By the aid of the first the slightest change in any part of the crystalline can be detected; by the other, oblique illumination, as it is termed, nebulous opacities of the cornea and the anterior part of the lens, are diagnosed and seen in their true position. The most perplexing kind of opacities are those which occur in connection with the vitreous body; for the discrimination of which much care is required, otherwise they may be confounded with the lamellar forms of cataract, those in which certain layers of the lens are opaque and others transparent. By the aid of the ophthalmoscope, striated cataract (that looking like the spokes of a wheel) appears to be very dark in colour, and by oblique illumination of a whitish grey. Occasionally the lens presents a glistening appearance, due either to crystals of cholesterin, or an excess of phosphate of lime. In dislocation or displacement of the lens, the dark edge only is seen lying behind the iris, the lens occasionally sinking down so low that even this cannot be seen until it is made to float up by rotating the eyeball.

The predisposing cause of a certain form of cataract has been made clearer by the synthetical method. Dr. Mitchell's invaluable investigation into the saccharine form of the disease has thrown light on its mode of formation. It has been demonstrated that by compelling an animal to take an excess of sugar with its daily food, saccharine cataract will be produced. This discovery was made whilst Dr. Mitchell was carrying on a series of experiments with curarised frogs. The animals were kept in a jar of sugar syrup, and in a very short space of time he noticed that their eyes lost their brightness, and the lenses became opaque; on removing the animals

to a dish of water, and there keeping them for a few days, the opacity disappeared. This remarkable discovery led to the conclusion "that cataract is a constant accompaniment of sugar poisoning." M. Kunde about the same time also instituted a somewhat similar series of experiments with regard to the physiolocal action of water in the animal economy, and to which Claude Bernard refers in his "Lacons sur les propertées physiologiques et les alterations pathologiques des liquides de l'organisme." The physiological importance of water in the animal economy is well understood; nine-tenths of the constituents of the body are fluid, and Bernard, in his valuable lectures, as might have been expected, points out, quite independently of the special qualities of water, that all organic fluids are not only allied to it by a mere general character, but owe their immediate physiological importance to the quantity first taken as a liquid, and then becoming a vehicle for the more perfect solution of the solid constituents of the body.

The quanity of water daily set free amounts on an average to about six pounds in weight, a portion of which is given off by the skin and lungs, and the rest by the kidneys—only a very small quantity of nitrogen is thrown off by cutaneous secretion of the lungs, whilst the rest passes away in the urine, which contains nearly 50 per cent.; by noting this we are enabled to measure the waste of the azotised materials. In the healthy male, about 480 grains of urea are excreted daily. This may be doubled or reduced by one half. In fever, when the bodily waste is great, it exceeds this, and in chronic heart disease it falls below the standard of health. There are other causes of variation; a diminution occurs in disease of the kidneys, when urea is retained, and accumulates as a poison in the blood; in another way, we have, indifferently, a diminution or

increase dictated by the azotised constituents of the food—for instance, raised by a flesh diet, and lowered by a vegetable one. The salts set free are far too imperfectly understood, both as regards their quality and quantity, to justify any very accurate estimate of them. The water of the egesta is derived in part by evaporation, and in part by dialysis, colloid septa, from the watery constituents of the blood and nutrient fluids of the body. The very large proportion of fatty matters taken as food, when compared with the small proportion actually contained in the blood, seems to imply that fat is only slightly needed; it therefore slowly mixes in the stream of blood. A small quantity is required to nourish the nervous tissue, and the rest is rejected or stored up as adipose tissue. With regard to the renewal of the tissues, the ingesta of food must be taken as fulfilling a two-fold purpose in the animal economy; that of replacing used up tissue, and diminishing waste by itself undergoing the combustion necessary both for the production of heat, and for the numerous delicate chemical reactions, which the comparatively uniform temperature of the organism necessitates. The food, in fact, need not go through the stage of living tissue before undergoing combustion and elimination. This is suggested by the change observed to take place in such substances as can scarcely be incorporated with the various structures, much less developed into them. The process which converts many of the organic salts of the alkalis into carbonates, in the short interval between their ingestion and their reappearance in the urine, or in the blood and fluids of the eye, is one which, as regards its results, is closely allied to the artificial combustion of the laboratory; it can scarcely be attributed to any other change than a combustion like that which furnishes the

carbonic acid of the habitual egesta. Be this as it may, physiological chemistry indicates that anything like true identity between the food and the tissues in general, is out of the question. Nevertheless, it is quite possible that the tissues in all cases possess chemical properties more or less specific to themselves. Life, although maintained by fixed laws, may certainly be changed and modified by disease; and thus by careful observation, we may ultimately arrive at some definite knowledge in the cycle of metamorphosis, by a circuitous route it is true, such as that of imitating changes brought about by an abnormal condition of nutrition (*Brinton*).

To return to diabetic cataract, the first gleam of intelligence in its formation was obtained by the synthetic method of studying disease. M. Kunde, travelling by a somewhat more circuitous route, produced similar effects. Kunde injected into the intestinal tract of frogs, a solution of sulphate of soda, and at the same time fed the animals on sugar. Osmotic action was thereby established, causing part of the water of the blood to flow towards the intestines. The blood being soon robbed of a large part of its fluid material, tetanic movements of the limbs were induced; these were soon followed by opacity of the lenses of the eyes, and blindness. The converse of this experiment, that of injecting water into the veins of a dog, increased the normal fluidity of the blood; but this could not be carried farther without producing fatal results. The dog's secretions were first diminished, and then, on injecting more water, they were entirely suspended; tetanic convulsions were now followed by death. In this way it became manifest that the relative proportion of the fluid and solid constituents of the blood cannot be changed with safety; and if so, as soon as a certain limit has been reached, disease and death will be sure to follow.

Dr. Mitchell, in his experiments on frogs, concluded that direct contact of the sugar with the eye was an essential element in the production of cataract. This is not the case, for a very slight increase in the density of the fluids of the eye will imperil the transparency of the dioptric media.

Dr. Richardson's researches led to the discovery that soluble substances which increase the specific gravity of the fluids, will induce lenticular opacity. Thus it is seen, we may produce *saline cataract* as well as *sugar cataract;* for this purpose it is simply necessary that the fluid injected into the circulation exceed 1.045 in specific gravity. At the same time it must be observed that, if the specific gravity of the blood much exceeds its normal state, abnormal density is produced in the lenses of the eyes, which lasts as long as the blood is unaltered in density. The deductions subsequently drawn from experiments of the kind, appear to be in accord with M. Bouchardat's views as to the cause of diabetes.*

Should we not, however, regard diabetic cataract as a directly physical effect produced in the lens by the

* Bouchardat's investigations into diabetes led him to conclnde that the disease is the resnlt, not exactly of the ingesta of an excessive qnantity of amaylaceons food, bnt rather of a rapid and excessive conversion of material by glncose; that this is in part due to a hyper-secretion of the pancreatic juice, and to some extraordinary activity of the ferment contained in it; and also from the stomach (as I pointed ont some twenty years ago) taking on a perverted action, by virtne of which it secretes a flnid containing a ferment analogons to that of the pancreas, which converts the starch into glucose. The excess of glucose in the blood, however, more frequently results from incomplete oxidation of that which is nsually present; and, under ordinary conditions, this would not exceed an amonnt which can be retained by the vessels, and oxidised by the ordinary acts of respiration. But, in the diabetic patient, there is an excess of glncose in the blood; and, in Dr. Richardson's words, as soon as this exceeds a certain defined amonnt, osmosis is established through the walls of the vessels.

surrounding fluids? It is, doubtless, the result of ormose, and in this way specific degeneration of the lens fibres is brought about. Other forces may be engaged in bringing about cataractous opacity, as we often find an increase of lens substance, differing in character from that observed after a lens removed from the eye is placed in water. It may be due to a pathological change in the globulin and albumen of the organ; and it is quite probable that an opposite state might result from a lower specific gravity of the fluids; in such a case the refracting media would assume another tint, from having been disorganised by excessive transudation (endosmosis) and distension.

Dr. Richardson's experiments led him to the conclusion that sugars and saline substances, with one remarkable exception, iodide of potassium, are alike productive of cataract. He found, 1st—in addition to sugar cataract there is producible what may be termed saline cataract; 2nd—the appearance of the cataracts as produced by different solutions vary. For instance, that produced by chloride of sodium, differs from that produced by grape sugar, &c.; 3rd—cataractous appearances are modified by the density of the producing body and are removable by reversing the conditions which have led to them. And as it is producible in a clear lens removed from the body, it is fair to infer that the cataract induced in the living eye is purely a physical osmotic change. It must be borne in mind, as a primitive fact, not only that an increase of the specific gravity of the fluids of the eye by sugar will destroy the refractive power of the lens, but that whatever soluble substance increases the specific gravity of the fluids, will also induce the same condition.*

* Dr. Richardson, F.R.S., "On the Synthesis of Cataract." Brown Séquard's Journal of Physiology, p. 449, 1860.

The extraordinary rapidity with which changes are produced in the fluids of the eye, may be gathered from the fact that salts of lithia can be detected in the eye in from fifteen to twenty minutes after they are taken into the stomach. The sulphate of quinine in about the same time increases the fluorescence of the refractive media. This observation led to the discovery that a substance resembling quinine is always present in the animal body. It is believed that animal quinine is descended from albumen; doubtless, it is an alkaline fluorescent substance of importance in the animal economy. When the eye is brought into the focus of the ultra-violet rays, immediately cornea and lens begin to glimmer with a fine opalescent light. Examined by the spectroscope, the dispersed light gives a spectrum in which the red is wanting, and blue and violet predominate.* The lens absorbs nearly all the blue rays of light, and the cornea and aqueous humour do so only to a less extent (*Brücke*). So-called *spurious cataract* may likewise be due to fluorescence of the lens.† To the observer, the electric light, when

* The discovery of substances—fluid, solid, and gaseous—by spectrum analysis, is one of the marvels of the age. By passing a ray of light through varions materials, and viewing them with a prism, certain portions of the spectrum are extinguished, while others are changed in colour; and "such changes in the spectrum indicate that those bodies so alter the motion of a certain portion of the rays of light, that it no longer produces certain effects upon the retina. The change referred to is termed absorption." Amongst solid bodies coloured glasses readily show phenomena of the kind. I note this fact because it is found that blue produces a pecnliar obscuration; and blne glass enters mnch into the formation of spectacles. Cobalt is the chief colouring matter employed in making blue glass: and this metal produces absorption of the red and yellow end of the spectrum, extending even to the green portion, with a slight prolongation of the blue. Blue glasses, for this reason, exclude from the eye that portion of the spectrum which is liable to induce an exciting effect npon the retina.

† The media of the eye exhibit the phenomenon of interference as well as fluorescence.

thrown into the human eye through a colourless solution of quinine, imparts to the lens the colour of a blue-green cataract. If, then, alkaloids are carried into the non-vascular tissues, is it not reasonable to believe that medicinal substances pass through the blood and act on the textures? And is it not also probable that they take part in every chemical change that occurs outside the blood vessels, as well as in the blood itself? Still further, may we not expect that among the multitude of new substances which synthetical chemistry is constantly forming, some medicine may be discovered which will not only have power to control the excessive chemical changes of the textures in fevers and inflammations, but also remove the products of insufficient chemical action, even in diseases which affect the non-vascular textures, as, for example, in cataract (*Bence Jones*).

Synthetical analysis has elicited an important fact: that, by the administration of certain therapeutical agents, a disease is induced in all respects resembling that which originates in a known abnormal condition. And from this we infer that by supplying the wanting, or lost chemical componant of the organism, we may, through such agency, arrest further degeneration, and restore nutritive function.

CHAPTER III.

SYMPTOMOLOGY, TREATMENT OF SECONDARY COMPLICATIONS, REMOTE AND PREDISPOSING CAUSES OF CATARACT.

By a very careful investigation of the earliest approaches of disease, we are enabled to seize upon the more important period in which medical treatment will be found of most avail. In the treatment of incipient cataract it is as necessary to inquire into the patient's general health as to seek out the cause of functional disorder. It is during the early stages of all diseases that attention will be most beneficially directed; and whilst we continue to avail ourselves of the accumulated experience of ages, in healing the more advanced stages of diseases, it is incumbent on us to endeavour to extend the boundaries of the science we profess to practice.

As I have already intimated, stomach derangements, dyspepsia, &c., are indirectly productive of much visual disturbance, muscæ volitantes, myodesopia, &c., which retain for a time the form of semi-opaque threads—a spider's web appearance—and, as in Sir David Brewster's own remarkable case, may induce lenticular cataract. Rust, in 1843, claimed to have first treated incipient cataract by evacuation of the aqueous through a puncture in the cornea, a practice stated to have been followed by improvement of vision. The medical treatment of cataract by oculists of a past generation partook of a wide and general character; the antiphlogistic, the stimulant, and the counter-irritant. The late Mr. Ware believed that means would be found by which an opaque

lens might be rendered transparent, without having recourse to operative measures of any kind. The remedies which appeared to him to offer some chance of success were the application of æther to the eye, to the brow, and temple; counter-irritants, and mercurial liniments. Jaëger attached importance to the employment of therapeutic remedies in the treatment of opacities; he published several encouraging cases in the Austrian "Zeitschrift für proktische Heilkunde," 1861.

M. Gondret agreed with Mr. Ware, generally, on the point of treatment. Majendie was much impressed by Gondret's success in the treatment of cataract, and which he looked upon as confirmatory of his views of the influence exercised by the fifth nerve over the nutrition of the eye. It will be remembered that his experiments showed that when the fifth nerve is divided, the nutrition of the eye is interrupted; the humours and the cornea soon becoming opaque. Majendie thought it by no means unlikely that cataract, which in very many instances is due to abnormal nutrition, may also arise from a morbid state of the nerve presiding over the nutrition of the eye. "Nature has her own way of removing morbid materials from the blood, and these methods are the more adequate and efficient in proportion to the vigour and constitutional powers of the patient, and the moderate amount of disease" (*Williams*).

The specific gravity of the fluid portion of the dioptric media is a point of very considerable importance. A given admixture of albumen is as much a necessity in the fluids of the eye, as in healthy blood, and it actually amounts to about thirty-nine parts in a thousand. Albumen is the chief element from which the plasma of the blood is elaborated. It is found in

excess in fevers and inflammations, especially in the acute or active stage of these diseases. The removal of water from the blood augments the quantity of albumen; consequently, poor living, or a copious drain upon the system, will reduce the blood below a healthy standard. A very grave deficiency in the quantity of albumen occurs in albuminuria—Bright's disease of the kidney—and this is associated with a diminution of the red corpuscles of the blood; a further deficiency is observed in a more advanced stage of the disease—and consequently we have degeneration of the tissues of the eye, opacity of the lens, and the gradual formation of cataract as a result.

The deficiency of albumen in the serum of the blood is in exact proportion to its excess in the urine (*Andral*). Healthy blood, then, should contain and circulate a due amount of albumen, together with a small quantity of fatty matter, mineral and saline materials. The saline matters in the blood tend to preserve the form of the corpuscles, and maintain the fibrin in a fluid state; but should the saline salts or sugar appear in appreciable excess, then the quality, specific gravity of the blood changes, and the transparency of the lenticular body is imperilled.

SYMPTOMOLOGY OF SACCHARINE CATARACT.

Sugar or diabetic cataract was first noticed by Dr. Rollo, a learned physician of the last century and the author of a "Treatise on Diabetes." Since his day, numerous cases have been placed on record, and with the introduction of the ophthalmoscope into eye practice, the diagnosis of the disease scarcely admits of a doubt. Indeed the appearances seen in the eye by the aid of the ophthalmoscope are so characteristic of the diabetic

diathesis, that the ophthalmic surgeon has designated the nature of the kidney mischief before it was suspected by the medical attendant or the patient. Diabetic cataracts are for the most part symmetrically developed, and the lenses notably increase in their anterio-posterior diameter, thus encroaching on the space of the anterior chamber so much that they may possibly interfere mechanically with the free play of the iris. The opacity is observed to take place in portions of one or more strata of the crystalline at once, the intermediate spaces being quite transparent. The colour and bulk of diabetic cataracts invariably indicate their soft consistence, though the patients may be middle-aged.

The subjective symptoms of sugar cataract vary only in a few essential particulars from those of more ordinary forms of opacity. Usually, the patient complains of a want of light, seeks a stronger light for reading and writing, whilst those labouring under cortical cataracts avoid a strong light, see better in a dull light or in twilight. Unless the disease is ushered in by retinitis, inflammation of the retina, the state of the patient's health and the prescnce of sugar in the urine will have already attracted attention, and called for treatment. The discovery of a small quantity of sugar in the urine can scarcely be considered otherwise than as an indication of its excess in the blood. In general, the morbific matter in connection with saccharine diabetes contrasts with that of gout and gravel. In diabetes the sugar is grape, a wholly unazotised principle produced by derangement of the processes of digestion and assimilation, whilst the condition of the urinary secretion is but a consequence of the disorder (*Williams*). In other words, the chemistry of diabetes is closely allied to that of nutrition in general, having for its chief characteristic the formation of sugar; the study of the physiological

function must therefore precede other researches; and when we are asked if saccharine cataract can be cured, the answer is, that as our knowledge of animal chemistry increases, we may hope to prevent an excessive formation of sugar in the body, and which is productive of diabetic cataract. By closely observing diabetic disease in connection with febrile and inflammatory affections, we notice that the kidney no longer eliminates sugar, or at all events it ceases to appear in the urine. This must be taken to indicate that its production is not necessarily by any means a permanent morbid process, and consequently we infer that it is possible to prevent its formation. Experience in the treatment of diabetes confirms this view, in several cases I have lost all trace of sugar in the urine of persons under treatment. The loss of physical strength, with gradually diminishing sight, is suggestive of a blood affection rather than of a nervous change. Dr. Dickinson, in describing the morbid pathology of diabetes, speaks of a change of tissue in the optic thalami, corpora striata, pons, medulla, and cerebellum, as well as in the whole of the convolutions of the brain.

We are unable to speak confidently of the action of any particular remedy in the treatment of diabetes. Upwards of a quarter of a century ago, I employed arsenic, hydro-sulphate of ammonia, and iron, with some success. A rigid milk diet, and great care in the choice of food generally, is certainly most important; all stimulants being contraindicated.

ALBUMINURIC CATARACT.

BRIGHT'S DISEASE OF THE KIDNEY.

Albuminuric changes in the refractive media of the eye are not generally seen until after retinal mischief has

commenced, and the disease has reached a chronic stage. Frequently before kidney disease is suspected, the ophthalmoscope has revealed the nature of the affection. A remarkable case of the kind came under my observation in 1873, which I placed on record (see *Lancet*, Nov. 15 of the same year). The patient was only eighteen years of age, and no albumen was found in his urine. Albuminuria, in fact, does not usually manifest itself so early in life. At a certain period, before middle age is reached, the patient is observed to lose flesh and strength, he becomes pallid, and the skin is very dry, although any unusual exertion causes free perspiration. Stomach derangements are complained of; the muscles waste; the face assumes a sallow hue; the lower eyelids become puffy. The urine is abundant and limpid, its specific gravity is low (1.006), owing mainly to the absence of urea. The retention of urea is an important feature in the more chronic form of albuminuria with contracted kidney, when its passage becomes more obstructed, and it is apparently in this way that the balance between formation and elimination is interrupted, and quite regardless of the compensatory power nature seems to set up for excreting the extra amount of water. For a time no trace of albumen will be discoverable, although at a later period of the attack considerable quantities may appear. Should a deficiency be observed in the blood, this may exactly coincide with an excess in the urine. The retention of the urea adds to the gravity of the case, as uræmia, or, should the elimination of the water not take place, dropsy, or both, may occur almost simultaneously, and at this period, from some simple cause, exposure to a chill night air, the sight may be suddenly lost.

From the degenerative changes observed by the ophthalmoscope in the vessels of the retina before

death, and from the microscopical appearances of the capillaries after death, I am inclined to believe that in Bright's disease, primarily, arterio-capillary degeneration takes place, and, secondarily, general fibroid change, in which the eyes and kidneys are indifferently implicated; the kidney disease, however, is not the cause, but the consequence of the condition of the vessels. The change, however, is not one of hypertrophy, but of degeneration (*Sir W. Gull*).

The disease is often hereditary. I have recently had under my care the third generation of a family, in whom cataract passed from the male to the female line, with loss of sight in the left eye, producing monocular blindness. To counter-balance the waste occasioned by albuminuria, a liberal supply of nutritious food is an obvious necessity, a milk diet, raw eggs beaten up with water and flavoured with sugar and lemon juice, &c. Alcoholic drinks must be avoided, as the majority of those afflicted with Bright's disease, by indulging in fermented liquors, have to a certainty hastened a fatal termination.

STRICTURE OF THE URETHRA AND ENLARGED PROSTATE, AS A PREDISPOSING CAUSE OF CATARACT.

Kidney affections are, as we have already, seen a frequent source of danger to the organ of vision. Syphilitic diseases are also known to predispose to similated opacity; but stricture of the urethra and enlarged prostate had not heretofore been known to be a predisposing cause of cataract, although it is understood that defective or insufficient action of any secreting organ may well be expected to impair the quantity and quality of the kidney secretion, and produce disease and degeneration of the tissues of

the eye. In November, 1872, I read a paper before the Medical Society of London, on the complication of stricture with lenticular opacity (afterwards published in the pages of the *Medical Press and Circular*, Dec. 4, 1872). Having in several cases noticed a singular correlation of these affections, I subsequently, and by the aid of my friend the late Dr. Beath, who was at the head of an institution where a large number of seafaring men were constantly under treatment for stricture and troubles connected with the urinary organs, was able to confirm my views, that stricture of the urethra should be classed among the predisposing causes of cataract. Fifty-six patients were examined, and seventeen were found to have lenticular opacities, varying in degrees of intensity. Kidney disease was diagnosed as a predisposing cause and complication in at least six, cataract seems to have arisen in consequence of the contracted state of the bladder and the chronic condition of the stricture; the retention of the urinary salts lead to calcareous deposits in the fibres of the lens. At the same time indications of degeneration and textural changes, prostatic calculi—premature old age—were observed; as the general health became improved, and the urinary troubles yielded to treatment, the sight also in some instances considerably improved.

RHEUMATIC AFFECTIONS, HEART DISEASE, AND OTHER COMPLICATIONS, AS SECONDARY CAUSES OF CATARACT.

When the skin fails to fulfil its excretory function, an increased amount of work is naturally thrown upon the kidneys, hence it follows that we have disease of these organs. The kidneys being unequal to the performance of their allotted task, accumulations of lithic and lactic acid take place in the blood, predisposing the

patient to rheumatism, &c. Certain morbific matters retained in the blood induce rheumatic, gouty, and other complaints, and exert a specific influence over vision, tending to produce lenticular opacity. Many changes that take place in the eye are very frequently associated with or arise out of a chronic form of rheumatic disease; the disorder passes gradually away, and leaves behind it considerable derangement of the digestive or assimilative functions, or it may be heart disease, as well as an excess of lithates, which will affect the integrity of the dioptric media. The heart, being the central organ of circulation, it might have been predicted that functional derangement of it would so disturb the balance of the circulation, and through it the cerebro-spinal system, spinal cord and brain, as to become an immediate or secondary cause of impaired vision. Associated with heart disease, it is no uncommon thing to find the arteries atheromatous, and the iris indicating premature change. Atheroma commences as fatty degeneration of coats of vessels; such a condition is known to occur within the eyeball, or the corneal structure. Arcus senilis, a fatty degeneration of the cornea, is a failure of nutrition from some nervous lesion, aggravated by pressure and friction of the eyelid. Blindness from functional derangement of the heart usually declares itself by retinal insensibility; spectral images are seen before the eyes, myodesopia, flashes of fire, indistinctness of vision, &c., are among the more prominent symptoms of coming mischief. I was consulted by a patient about a gradually decreasing state of vision in both eyes; upon examining the eyes, opacities were detected in the lenses, but as the disease was found to be part of a long-standing heart affection, my treatment was directed to this organ, and was attended with success, for at the expiration of two years the

lenticular opacities had very perceptibly diminished. A number of cases might be cited to show the great benefit derived from medical treatment. Disease is in every case a distinct entity, a departure from the natural condition, which must be met by appropriate treatment and by placing the patient in a favourable condition for its arrest and cure.

The capsulo-lenticular cataract of Mackenzie is a form of disease arising out of secondary causes. The pathological investigation of capsulo-lenticular disease appears to show that the capsule is rarely implicated in the change, that it is simply an inflammatory deposit of lymph on the transparent homogeneous enveloping membrane. The exceptions to this rule are traumatic injuries, and inflammation of the hyaloid; it has, however, been satisfactorily demonstrated that in the majority of cases of cataract the capsule remains intact and perfect. In fact, opacity begins in the cortical substance of the lens.

SOFT CATARACT.

Soft or fluid cataract is occasionally seen in adult life; but it is more often an inherited disease, when it is termed congenital cataract. There are two well recognised forms of congenital cataract, either of which may for the first few months of infant life be unrecognised. This is the case with the lamellar variety, a particular form only noticed at a period when the eyes of the infant usually begin to follow objects in daylight, and when a keen-sighted mother will be sure to observe anything unusual, as a white spot in the centre of the pupil of the eye. If a more careful examination is made, the circumferential or marginal portions of the lens will be seen to be clear,

unaffected by the cataractous disease. The child is usually thought to be delicate, or is said to be strumous; rachites is often set down as a predisposing cause of the abnormal condition of the eye. As the child grows older it can only be attracted by large and bright objects, and these it will attempt to bring very close to its eyes. At a later period of life convex-glasses may afford considerable relief, especially when the pupils have been dilated by atropine. Aided by spectacles, vision may remain useful for many years, and it is better to postpone operative measures until medical treatment has been fairly exhausted.

The congenital form of cataract more commonly seen is of nearly uniform cloudiness—bluish-white or opalescent in colour; this variety rarely remains stationary. In the first instance the vague and unintelligent look of the infant attracts the mother's attention; it does not observe her movements, nor does it recognise surrounding objects, large or small. The eye when open is continually in motion, rotating, nystagmatous, a movement which is likely to become a confirmed habit. To avoid this rolling of the eyeball, it is advisable to operate at an early age, and as soon after teething as possible, glasses can then be brought into early requisition to compensate for the defect of vision, and assist education.

The hereditariness set down as a cause of congenital cataract presents remarkable deviations and predilections in families so afflicted; for instance, it will affect the females while the males of the same family will escape, or will miss one member and then pass to the next two or three males and females quite indiscriminately. The most recent instance of hereditary cataract that has come to my notice, was that transmitted by a great grandfather, his sons were similarly affected and the

daughters escaped ; it subsequently passed to the female side of the family, and is now confined to the female branches, who are all more or less affected in the third and fourth generations. A singular circumstance must be mentioned in connexion with this afflicted family, they were each in succession operated upon in a general hospital with the loss of one eye, vision in the other remaining very imperfect.

SPURIOUS CATARACT.

The sea-green cataract of glaucoma is not an opacity of the lens nor of the media, it is simply a reflection from the retina, probably due to inflammatory changes of the internal eye. The ophthalmoscope has cleared away the mist which for so long hung about glaucomatous cataract. The capsule of the lens becomes distended by an increase of the fluid contents and presses it forward towards the iris. There is, however, a general distension of the eyeball, which produces a peculiar stony hardness, and is a well-marked symptom of the disease. Glaucoma, if seen in an early stage, is undoubtedly amenable to medical treatment, combined with topical applications, myotics, which allay the brow pain. The instillation of a weak solution of eserine, or the insertion of a small disc of eserine, will relieve intra-ocular tension and pain. In the more advanced stages of the disease, the acute form, either iridectomy, division of the ciliary muscle, or sclerotomy (each have their advocates) should be resorted to without delay. Division of the ciliary muscle has been practised by myself in a large number of cases with success.

The so-called spurious cataract of older writers is a whitish mass of effused lymph, dipping down to the lenticular substance—the sequala of an inflammatory

attack, rheumatic iritis, &c. Siliculous capsulo-lenticular disease is the stratified or nuclear cataract of the present day; it occupies an intermediate position between the central and circumferential portions of the fibres of the lens. It has, so far as I am aware, no disposition to spread towards the cortical substance, and on this account is sometimes described as perinuclear cataract. The disease has been noticed to occur very frequently, and is believed to be due to convulsions of childhood (*M. Arlt*). During the fits, the violence of the muscular movements produce displacement between the denser fibrous portion of the lens and the softer external parts, thus tending to produce an alteration in the physical properties of the interposed layers; arrest of nutrition, leading to atrophy. A somewhat nearly allied pathological change occurs in luxation of the crystalline. Dislocation, luxation of the lens, occasionally follows a fit of whooping cough, or a violent fit of coughing and sneezing. The dark margin of the double edge of the lens is only seen in such a

Fig. 7. Traumatic dislocation of the lens into a sac or pouch.

case by a slight inclination of the patient's head, or after the pupil has been fully dilated. Persons who suffer from an accident of the kind are extremely myopic, and often astigmatic. A somewhat rare case of congenital luxation of both lenses lately come under

my care, in the first instance medically, and subsequently, from the violence of the inflammation that ensued, surgically; for the lens, after a slight blow on the eye, acted as an irritant foreign body, and ultimately extirpation of the globe was obliged to be resorted to. A report of this interesting case will be found in the *Lancet*, May 27, 1876. Traumatic dislocation of the lens is more often the result of a violent blow on the eye, when the lens may be forced through the anterior chamber, and lodged in a sac or pouch between the coats of the sclerotic and conjunctiva, as represented in *fig*. 7.

SIMULATED AND SPECTRAL OPACITIES OF THE DIOPTRIC MEDIA.

Imaginary or phantom derangements of vision, simulating cataract, are commonly met with in persons of a nervous temperament, to whom they appear alarming, and give a good deal of annoyance. The attention is first directed to moving bodies, muscæ volitantes, passing before the eyes. Opththalmoscopic muscæ are actual opacities visible to the ophthalmic surgeon as well as to the patient; these are termed ectoptical, as distinguishing them from entoptical myodesopia; such appearances are frequently associated with an incipient form of cataract, and when a minute spec in a lens fibre is seen by a myopic patient with varying intensity. Soon after the middle period of life has been passed, the lens of the eye commences to change in shape, and deepen in colour; and both ectoptic and microscopic investigations have demonstrated that, as age advances, the vitreous humour becomes richer in corpuscles and filaments, which are productive of certain muscæ. The near-sighted are more likely to be affected by entoptical

phantoms than other people, while those whose eyes are perfectly adjusted, possess the power of accomodation in perfection—the emmetropic, are rarely affected with myodesopia, or, if present, they are unheeded by the percipient elements of the retina. Usually, when rays of light fall upon the retina in a state of dissipation—as they do in myopia and presbyopia—muscæ are perceived; and hence it is that myopes and presbyopes find their troubles diminish by the use of appropriate glasses. Time corrects certain defects of the myopic eye, and it may become presbyopic by age.

If a round or irregular body is seen fixed before the eye, and is constantly afterwards observed in the same position, it will be regarded as a symptom of commencing cataract. When the eye is examined with the ophthalmoscope, a greyish disc, or an irregular pale-looking cloud or body, is discovered in the vitreous humour. By carefully testing and examining this body with the convex lens and the ophthalmoscope, it can be ascertained at what depth it is situated, if nearer the anterior or posterior part of the vitreous. Whilst, then, the discovery of the presence of muscæ, either fixed or moving, is often a cause of serious uneasiness, an increased knowledge of their nature will at once tend to allay the anxiety of the patient, and enable him to give a clear and intelligible account of their more remarkable phenomena. Entoptical images are visual impressions of objects present within the eye itself; the most important are perceptions of opacities, and obscurations of the refractive media of the eye. They become apparent when, by illuminating the eye, their shadows are made to fall on the retina.

The increased occurrence of *visio phantasmata* observed under particular circumstances, offer an extensive field for experimental research. When the eye is in a

normal condition, the lachrymal fluids, as they flow over the cornea, are frequently visible in the diffused light of day. Deeper placed images can occasionally be seen without difficulty, and a number of apparently separated beads will give rise to a belief that there are several loose bodies in the interior of the eye. For a more accurate investigation of the position and nature of the various irregular fixed and moveable bodies, an object glass of a microscope of an inch focus, and small pencils of parallel converging and diverging light, should be used.

Myodesopia, or muscæ volitantes, although usually regarded as a symptom of deranged health or stomach disease, may, from muscular fatigue, and asthenopia, assume a serious morbid condition. In some instances

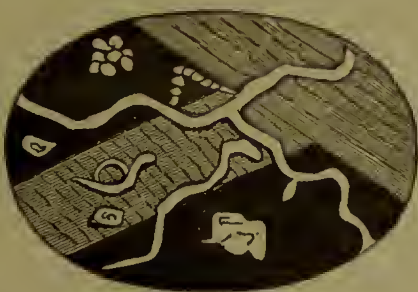


Fig. 8. Entoptical muscæ.

the field of vision will be peopled with images of all kinds. To view these entoptical muscæ with precision, and to determine their situation and dimension—or rather to obtain data for determining them—we employ a pencil of bright light and of limited extent. It must be borne in mind also, that images of filaments in the vitreous humour, as well as certain spectra arising from the interposition of eyelashes and lachrymal fluids, are

frequently visible in the ordinary daylight; whilst in disease, other entoptical objects—as those represented in *fig.* 8—obtrude themselves on the field of vision. These bodies, and numerous others, were always visible to the eyes of a myopic patient, when fatigued by over-work, and suffering from indigestion. The supposed test of danger or harmlessness of certain entoptical apparitions, referred to, however, by Sir Thomas Watson, viz., that "the simple and easy criterion is that those muscæ which are motionless when the eye is at rest, and move with it when in motion, are signs of danger to vision; and those which sink gently downward when the eye is fixed, are innocent," is entirely fallacious, chiefly so, because patients having no scientific knowledge of the subject will content themselves by applying the test, and acting upon it, and thus may be induced to allow an important symptom of disease to remain unheeded and uncared for.

The result of my experience is that blind, insensible spots in the retina, do appear to "sink gently downwards," as well as simple muscæ, when the eye is directed steadily towards some bright object. This is explained by the fact, that, if the eyes are brought to bear, as is commonly done, on the top of an object, so that the inspected image may be viewed against the sky, the eyes will be found to have an almost irresistible tendency to drop, at the same time the blind spot of the retina changes its place. Even when the object towards which the eyes are directed is not placed high above the level of the axis of vision, they yet have a tendency to sink downwards, or to move in some other direction, thus causing the insensible spot to move imperceptibly. There are other complicated conditions which render this test, supposing it were a true one, difficult of application. The more deeply situated bodies in the

vitreous humour cannot be seen to move over the retina, and in diseases of the nervous system, muscæ occur which, "like dreams, are merely the result of efforts by a suffering brain to realise impressions made upon it." Accurately conducted experiments are very necessary; and for ascertaining the exact position and nature of entoptical images the converging pencils of light should be drawn from a pure source, as a white cloud, or the diffused light of a northern sky; at night, from a gaslight, or steady lamp-flame, placed about twenty feet off; by the aid of a convex lens, and from such a source of light, a bright image may be formed at or near its principal focus. In this way a rapidly convergent, and therefrom divergent pencil may be thrown into the eye—a divergent or convergent pencil, at the pleasure of the observer.

Fig. 9.

Fig. 10.

With the flame of a lamp placed at a distance of twenty feet, the following experiments were made on the eyes of a clergyman (Mr. T.) who for several years was distressed by a dread of cataract, but whose troubles arose from muscæ, and a sluggish lachrymal gland, hence very irregularly shaped tears, both convex and concave, were seen to pass slowly over the front of the eye. In *fig.* 9 the tears are seen through a divergent pencil of light. These were convex tears, since they were

very bright, and the image produced a shade or areola, one had a dark central spot. The next (*fig.* 10), a concave tear seen through a divergent pencil, the image of which was dark, and the surrounding areola lighter. Throughout the crystalline lens were scattered numerous bodies, either opaque or semi-opaque, with a round or oval outline, and a bright central spot, as represented in *fig.* 11. After very carefully made observations, it is scarcely possible to confirm a statement to the effect "that the whole wide black ring of such bodies is constituted of internal fringes." The shading of the areola around the objects is given roughly, to imitate the actual appearance, and to render the lucid band and central brightness of the opaque bodies more prominent; and from a cause not quite so easy of explanation, the bright portions were invariably much lighter than the surrounding areola; they were also accompanied with prismatic bands, or coloured circles.

Fig. 11.

Peculiarities of focal adjustment in this patient's eyes exhibit other points of interest. The power of accommodation, from a distance of one inch and a half to the horizon, was possessed by both eyes when in a normal condition, but when a single horizontal straight line was viewed at a given distance, say twelve inches, and turned round in a plane perpendicular to the optic axis, it was seen more clearly in some positions than in others. A vertical line appeared perfectly erect, but one sloping at an angle of 45° appeared to be doubled. With the left eye, a horizontal line also appeared doubled; when the eyes were suffering a good deal from the effects of overwork, on looking at a distant point,

all near objects appeared to be doubled, each eye having its own image, and the nearer the object, supposing the eye to be directed to a distant point, the farther apart were the two images. It was subsequently ascertained that the patient was astigmatic as well as myopic.*

With regard to the investigation of the filaments in the vitreous body on looking downwards, and, indeed, fixing the eye during these investigations upon an object placed above, or even parallel to, the axis of vision, it was seen that the images of intra-ocular bodies moved about, so much so as to render their examination somewhat difficult, and after some care the following conclusion was arrived at. The seemingly loose beads in the vitreous were observed to be small pieces of a series of filaments. The annexed (*fig.* 12) represents a portion of the network of fibres, and some loose beads visible in the vitreous, seen by means of a divergent pencil of

* Dr. Thomas Young first observed this asymmetry of the dioptric system in his own eyes. He was myopic, he saw in his optometer double images of the threads intersect each another at seven inches from the eye. The optician Cary, to whom Dr. Young communicated his discovery, stated to him that he had often found that near-sighted people distinguished objects much more acutely, when the glasses suited to them were held in a particular, oblique, direction before the eye; by tilting the glasses, at least when strong glasses are necessary, a certain degree of astigmatism may be corrected. Young carefully studied and delineated the form of diffused spots. The source of astigmatism he sought in the crystalline lens, because it continued when he plunged his cornea in water, and replaced its action by that of a convex lens. He now assumed that an oblique position of his crystalline lens was the cause, and even thought that from the diffusion of images at a point of light, it might be deduced that the two surfaces of his lens were not centred. In a double point of view, therefore, Young's eye, says Donders, "presented an exception; the refraction was stronger in the horizontal than in the vertical meridian, and the cause lay principally in the lens." —*Phil. Trans.* vol. 83; *Young's Miscellaneous Works*, edited by Peacock, vol. 1, page 26.

light. When my entoptical studies were commenced, the numerous apparently loose beads in the vitreous humour appeared to be quite disconnected, and when in motion it was impossible to say that they were in

Fig. 12.

Fig. 13.

the condition of objects connected together. *Fig.* 13 imperfectly represents some of the smaller and larger globules, seen by a divergent pencil of light, when the eye was in a tolerably good condition. But in a short time afterwards, by close application to reading, deterioration of sight occurred, from the greater visibility of beads in the vitreous. These increased rapidly both in number and prominence, and several of the larger size, or more conspicuous bodies, were united into a series of links, chain-like. In process of time a regular net-work of fibres became visible, and, in the diffused light of day, were converted into a connected chain of beads, as in *fig.* 14. After further observations, the conclusion come to was that every visible bead in the vitreous, whether seen in the diffused light of day

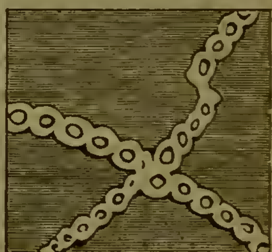


Fig. 14.

or by means of a divergent pencil, was in reality a filament or portion of a fibre, and every thread that came into view could be at once located, even a stray globule could by an effort be restored to its place in the meshes of the web with facility.

The entoptical investigation of this patient's retina was equally interesting. At each contraction of the left ventricle of the heart, a corresponding movement in the arteries of the retina produced phantoms in the form of greyish elongated bodies, sometimes, though not invariably, phosphorescent. The sentient surface of the retina appeared to lie below the arteries; and this is highly probable if we consider for a moment in what way these phantoms are produced. It must be admitted, however, that these phenomena are not entirely to be relied upon in their results, consequently the data obtained must be taken for what they are worth. As the result of careful observation, it may be stated that a subtle black ring round most—if not all—of the capillary dots, falling upon the more sensitive portions of the retina, can be detected, and, in some rare instances, a very slight central brightness can also be seen. That the capillaries do not actually touch the sentient surface, although they approach it very nearly, appears to be quite certain. In many cases a few excessively minute dots are perceptible lying across the foramen centrale, but so minute as to be barely seen. These small dots somewhat resemble a network of capillaries around that region, although small. "These dots must be regarded as shadows, and until the microscope shall have discovered another cause, it will be hard to say that they are not vessels" (*Jago*).

With regard to the detection of certain almost bloodless portions of the retina, it is not always possible to distinguish or separate them from more harmless

muscæ volitantes, by the uncertain test of their immobility; for when the eye is directed toward an elevated object, they will sink gently downwards, and the observer will often rest satisfied with a cursory observation, shrinking from the possible discovery of danger to vision which a more carefully instituted examination might lead to. When a more accurate series of entoptical experiments shall have been made and recorded, there will be little or no difficulty in mapping out anæmic portions of the retina. It is true that a given spot will appear to gently sink down, but only *appears* to do so, for it is really stationary, when the eye is directed to any spot on a level with or lower than its own elevation.

Although the more common muscæ will be seen to sink gently downwards—occasionally rising, and again descending—phantoms of the lachrymal fluids move either laterally or longitudinally, and at such times the anæmic portions of the retina remain fixed. We may, however, by noting some peculiar colour or shade, pick them out from amongst other entoptical images, and their pearly brightness, once seen, will not be easily forgotten. These, the more serious forms of muscæ, are also the most obtrusive of entoptical objects, being at all times visible, both in daylight and by artificial light. They are the spectra which accompany overwork of the eyes, and will disappear only after a long period of rest.

In this particular case it was an occupation for spare moments to note the several remarkable effects narrated. My patient observed that reading or writing always produced muscular contraction—a spasm of the voluntary muscles—and this rendered the phantom-like muscæ more conspicuous. Painting did not appear to produce the same unpleasant effects as reading. He

invariably found that looking at coloured objects or a landscape was not only less trying than reading or writing, black and white, but after the fatigue attendant upon the exercise of either, that turning to painting, or taking a short walk out, soon restored sensibility to the retina. *Fig.* 15 represents a portion of the field of view repeatedly observed by a divergent pencil of light, after an hour's reading. A, portion of fibre; B B, clusters of spectra, probably beads in the vitreous humour, forming parts of larger fibres; C C, anæmic portions of the retina; D D, deeper fibres in the vitreous

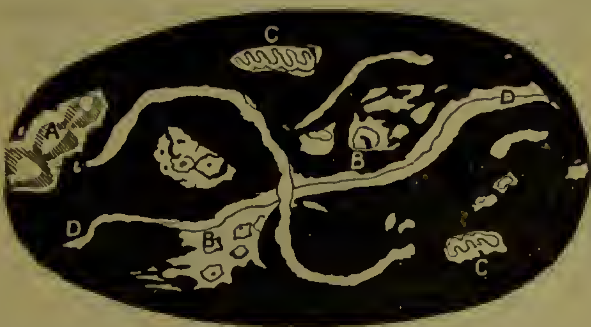


Fig. 15.

body. The background is shaded to represent the internal eye and give prominence to the spectra, the oval form indicating that the horizontal plane of the field was more thickly peopled. The images sank downwards when the eye was brought to a state of rest.

Pearly spectra are associated with overwork and dyspepsia, and are then palpably seen, as well as in affections of the outer coat of the eye. The student sitting late over his books or microscope; the astronomer at his telescope, after long hours of night watching; the successful barrister or lawyer should be warned

to desist by troublesome spectra, which recurring ultimately confuse and dim sight. All those persons whose occupations make increasing demands upon the organ of vision, intently occupied, it may be, in a badly-lighted and ill-ventilated room, working in a bent and constrained position for many consecutive hours, are liable to suffer from muscæ volitantes. A brief record of a case or two will best picture the anxiety and annoyance they are likely to occasion. A gentleman much occupied as a draughtsman, suffered from spectra, which increased to an alarming extent, so that after two hours' application at most he could no longer proceed with his work. A large blur or black blot settled down over the drawing on which he was engaged,

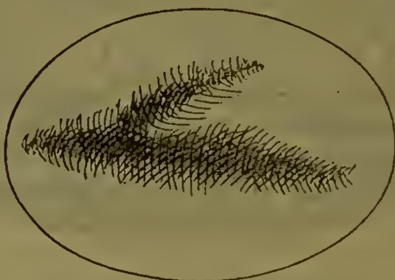


Fig. 16. Fern-like speck.

sometimes in the form represented in *fig.* 16. If the day were cloudy, or health disturbed, the muscæ were much increased, and always appearing to move in the horizontal plane. When walking, the spectra took other forms, generally from six to ten feet in advance, and rather above the line of sight, then looking like groups of pearly drops; on raising the head slightly, they then resembled clusters of crystals, as in *fig.* 17. Apparitions of the lachrymal fluids were nearly always visible, especially so after fasting or any fatigue, but much

less troublesome when walking in daylight, or during sunshine. At other times the spectra had the appear-

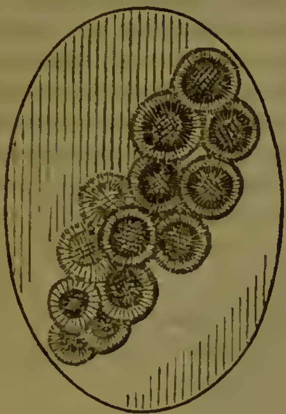


Fig. 17.

Fig. 18.

ance of raindrops surrounded by brilliant haloes; and then again descending quite slowly, in the form represented in *fig.* 18. This patient found relief by using concave glasses, and taking for a few weeks Kirby's phosphorus, iron, and nux vomica pills.

A second case, that of a *law-writer*, who had always been myopic; after an unusual amount of fatigue and anxiety in preparing parliamentary papers, became subject to very annoying spectra. These were associated with hemiopia—insensibility of a portion of the retina—a partial blindness, obscuring half the field of vision. The celebrated Dr. Wollaston had two attacks of a similar kind, and mentions having met with hemiopia in other persons. He relates of a friend of his, who for sixteen years, and whenever suffering from stomach derangement, the centre of vision in both eyes was nearly obscured; in the case of another friend, all objects situated to the right-hand were obliterated. In

writing, for instance, he could see his pen, but could not see his hand moving it. The hemiopia was preceded by some trifling derangement of health, accompanied by a severe headache. He never, however, completely recovered the attack, and objects to the right-hand were always imperfectly seen. Letters and words were broken up, portions of words were more or less blotted out, and on throwing the head backwards, things had the appearance of being covered with snow, or branches of trees, as represented in *fig.* 19.

Fig. 19.

I have observed very peculiar phenomena produced by groups of scotomata. I have also seen cases in which very small type was more easily and more quickly read than larger, because in the latter case a whole word is not seen at once, and letters still larger are only partly visible. The glimmering usually complained of is due to the fact, that in slight movements of the eye, the letters form their images alternately on sensitive and insensitive parts of the retina, and thus come and disappear, sometimes with change of form, and in accord with the irregular displacement of the percipient elements (*Donders*).

Mr. B. A., a tutor, myopic from childhood, on getting out of bed one morning, found to his horror

that he had suddenly lost the sight of the right eye. A peculiar dense cloud appeared before every object, and he saw only a small portion of the window. It first occurred to him that his blindness must be due to cataract. The peculiar character of the obscuration of vision at this moment is represented at B, *fig.* 20. Upon suddenly closing both eyes, a number of spots darker than any cloud appeared to fall over the pupil. In a strong light he was able to discern his hand if held very near to the temporal side of the head, but not otherwise. On assuming the erect position, this peculiar body almost disappeared. Soon after these pearly spectra gradually expanded into a spider-like body, represented at A, *fig.* 20, and following the motion of the eyeball, either from right to left, or from above downwards, and then again it occupied the centre of vision. On a particular day, whilst lying perfectly still on the couch, a black inky-looking fluid proceeded from an ovoid body occupying a position at the top of *fig.* B;

Fig. 20.

and on another occasion, the spectra became transformed into the crenated body C. On suddenly stooping, this again became transformed into the spectral body D. The space on either side of these several bodies was

nearly a blank. After some weeks of medical treatment, the spectra suddenly vanished, and Mr. B. A. was able to read with — 8 glasses, which quite neutralised his myopia. Before he consulted me, it was believed that these symptoms were diagnostic of detached retina; but upon a prolonged examination with the ophthalmoscope, I could not confirm this view of the case. A staphyloma posticum was seen encroaching on the optic disk; the vessels were very small, and a few irregular bodies were floating in the vitreous, so that the spectra were due to changes in the nervous tissue or to insensible portions of the retina. The treatment consisted of nervine tonics, and which gradually restored vision.

Ophthalmoscopic investigations have shown almost without exception, that in moderate degrees of myopia, changes in the choroid occur; the expression of an atrophic condition of this membrane is often associated with atrophy of the sclerotic, both of which are dependent on distension of the posterior part of the eyeball. Myopia and posterior staphyloma have become almost synonymous (*Donders*). Atrophy of the choroid begins as a dark crescent on one side of the optic disk, and is a frequent accompaniment of myopic vision. This enlarges and forms a broad ring around the disk, and the thinned and wasted choroid exposes the sclerotic coat, further inflammatory charges may lead to masceration and total loss of sight.

The older surgeons and philosophers, Pitcairn, Boerhaave, Plenck, and others, regarded all spectra with considerable alarm, and believed that they were always indicative of retinal mischief. De la Hire wrote —"Only presbyopes were troubled with muscæ;" those amongst the Royal Academicians of Paris who have given attention to the subject, observed that myopes were

not more exempt than presbyopes. "Short-sighted people are least liable to muscæ" (*Wardrop*). Donders is quite satisfied that myopes are more troubled with muscæ than presbyopes; and Mackenzie, that pearly spectra can be seen by all eyes, when sought for through a pinhole, or through the eyeglass of a compound microscope. Experience long ago led me to the conclusion that the emmetropic eye—that is the eye of normal conformation and visual power—is seldom troubled with spectral muscæ, myodesopia.

I have, however, occasionally observed myopia in one eye and presbyopia in the other, and then a slight cause will produce muscæ. In the circles of diffusion of smaller surfaces of light, muscæ exhibit themselves with extraordinary vividness, and in general the more diffuse uniform aspect of objects is the condition under which they appear more distinct. In myopes they are seen mostly on uniformly illuminated surfaces. Therefore myopes find a diminution of these symptoms by using concave glasses, which with them remove the uniform diffuse appearances. But other complaints continue to arise, especially when patients grow uneasy about their symptoms, and have once accustomed themselves to attend to them. I have seen instances in which anxiety about muscæ volitantes amounted to a monomania, against which all reasoning and the most direct demonstrations were vain. This is especially the case when morbid changes in the vitreous have supervened. The existence of morbid changes must be admitted as soon as turbities in the vitreous humour can be made out with the ophthalmoscope, and to these a real pathological importance must be attached (*Donders*).

I proceed to give one other case which, in my opinion, fully establishes the fact that by neutralising

myopia, a marked diminution of spectra will take place, if they do not quite disappear. *Fig.* 21 represents the field of vision in the left eye of a patient, Mr. F. M.

Fig. 21.

These appearances were first noticed by him on a dark winter's day, when his eyes were accidently directed towards a bright part of the sky. The band A A was certainly lachrymal fluid passing slowly over the cornea. B, another band of the same, with pearly globules arrested in the stream. C C are images of fibres in the vitreous humour. D, a group of beads indistinctly seen when compared with those at B. E indicates an anæmic or insensible portion of the retina.

Fig. 22.

The field of vision in the left eye and under the same condition of light, is seen in *fig.* 22; this eye

having had an appropriate glass fitted to neutralise the myopia, the floating band of fluid only remained, and this was now dimly seen. The filaments in the vitreous

Fig. 23.

were, however, still visible, but several of the loose bodies disappeared from view. *Fig.* 23 represents the appearances seen when the eye was directed towards a brilliant sky. In this very bright light, although the sight was unprotected, the images appeared to be fewer, and were almost wholly confined to the anæmic portion of the retina; the deeper filaments in the vitreous, with some fragmentary portion of the lachrymal fluid, alone remaining.

A concave glass was now tried, and the eye once more directed towards a brilliant sunlight, when nearly all the spectral images disappeared as if by magic; those represented in *fig.* 24 being only seen. There can be no doubt, then, of the value of appropriate glasses in these cases. Attention to the general health is of equal importance in the treatment of myodesopia; and apparently slight stomach derange-

Fig. 24.

ment, especially when associated with overwork, being more than sufficient to produce spectral bodies, as seen in the following case :—A gentleman, after a period of prolonged anxiety and study, found himself greatly depressed and worried by the continual appearance of muscæ, *fig.* 25, such bodies being extremely numerous,

Fig. 25.

and moving about with a serpent-like form before him, the groups of bead-like bodies were large and conspicuous ; the whole field of vision being peopled with entoptical spectra.

In this case, although hypermetropia* was well

* Hypermetropia is a very freqnently associated anomaly of vision, it is a condition in which the principal focns falls slightly behind the retina. This is a totally different anomaly to that known as presbyopia, when near objects are no longer seen distinctly. Presbyopia exists, when in consequence of the increase of years, there is a diminution in the range and power of accommodation, and the near point is removed too far from the eye. The colour of the lens is deepened nevertheless. It is, however, a normal condition of the normally constructed eye at a more advanced period of life, and simply rests on an altered situation of the near point.

Hypermetropia freqnently arises from a congenital malformation of the eyeball. It may, however, shew itself after an exhansting illness, or as a conseqnence of some other malady, and in such a case vision is, for near and distant objects, equally indistinct. With advancing years the distnrbance of vision prodnced by hypermetropia is increased by presbyopia, which to a certainty will be associated with it. The form of the eyeball in the hypermetropic is smaller in

marked, no relief was obtained by convex glasses. Medical treatment, rest, and change, effected a considerable improvement in the patient's health—the distressing headaches and giddiness no longer troubled him—and when, at the end of three or four weeks, glasses were once more tried, great relief followed, and the spectral images gave no further anxiety.

---

all its diameters, and the image of any object looked at is also smaller. This arises from a shortening of the axis, by which means the optic centre is brought nearer to the retina. Professor Donders to whom we are indebted for much of our knowledge of refraction and accommodation of the eye, first pointed ont the frequency of the occurrence of hypermetropia, and he divided the abnormal condition of sight into absolute, relative, and facultative. *Absolute* hypermetropia is present when with the full exercise of accommodation, and the strongest convergence of the visual axis, neither parallel nor divergent rays can be brought to a focus at the retina, unless with the aid of convex glasses. *Relative* hypermetropia exists when both parallel and divergent rays can be brought to a focus by exerting the power of accommodation and converging the optic axis to a point nearer the object. *Facultative* hypermetropia is when the person can see both near and far objects by exerting his accommodation, either with or without glasses ; but this becomes absolute by age, weakness, or fatigue.

Both in presbyopic as well as in hypermetropic individuals, the cornea is flatter than in the normal eye. With many people the near point of distinct vision lies not more than ten or twelve inches from the eye. What is termed latent hypermetropia often exists in even yonng persons of twenty ; it prodnces in them a diminished acuteness of vision, and reqnires appropriate glasses for its correction. In some instances, patients even require a + 10 to enable them to read at twelve inches ; as withont them the eye becomes tired, and cannot adapt itself to parallel rays, and close work cannot be followed for any length of time. With a proper glass, diverging rays are brought to a focus. The presbyopic, on the other hand, can see better at longer distances, cannot read at ten inches, the letters are not black, and have an indistinctness from a tendency to become donble from *diffraction*; but glasses of + 30 correct this. Thus it becomes apparent that each eye has not only a definite refraction, but a different degree and power of accommodation ; this may be normal or abnormal, and quite independent of *refraction*.

CHAPTER IV.

THE SURGICAL TREATMENT OF CATARACT.

THE CURE OF LENTICULAR OPACITY BY THE EVACUATION OF THE AQUEOUS HUMOUR.

Lessons of a practical and useful nature have been deduced from a physiological and synthetical investigation of cataract. We learn that opacities in the incipient stage can certainly be cured, and that deposits in or over the anterior surface of the capsule can be removed by medical treatment; in some instances apparently by the solvent action of the aqueous humour alone. The way in which the later mode of cure has been effected was made known by Sir David Brewster in the year 1836, when his paper on the "Theory and Cause of Cataract" appeared in the Reports of the British Association. A later paper from the same pen was published in the Transactions of the Royal Society of Edinburgh, 1865, "On the Cause and Cure of Cataract." The experiment was made on himself, and there can be no doubt, by the means

described, that Sir David actually arrested the formation of cataract, and which for some time had given him great anxiety.

I asked him for further particulars, and on the 30th of June, 1865, he replied:—Cataract can be cured—1st. By the repeated evacuation of the aqueous humour, thereby inducing a more healthy secretion. 2nd. By injecting distilled water, or a fluid equivalent in composition to the aqueous humour, after evacuation of the natural secretion. 3rd. By injecting (especially in cases of soft cataract) a fluid containing more albumen than exists in the aqueous humour, when evacuation alone is not successful. 4th. By employing a medical agent: in my own case, the pulvis salinus compositus.

The account given of the incipient attack of cataract which attracted Sir David Brewster's notice, and led him to devote much attention to the subject, was, that whilst playing at chess with a friend, streams of light appeared to radiate from the flame of the candle, causing him much annoyance. After a short time the flame was surrounded by lines of light having an imperfectly triangular form, and more or less deeply tinged with prismatic colours. On walking home, figures were seen round the moon and other sources of light, and after much consideration and examination of the phenomena, he came to the conclusion that the lines and prismatic colours proceeded from his own eye. He thought that the fibres of the lens had become separated near the centre, the fissures extended towards the periphery, and that this was due to an alteration in the specific gravity of the "Liquor Morgagni," which unites into one transparent body the mass of fibres that compose the crystalline body. Had this opacity not been detected, he added, "the process of desiccation would have gone on, and the whole of the laminæ of the lens would have

become separated, and true cataract induced, which could only have been cured by an operation." Sir David thereupon determined to try and find a remedy for the deranged state of his vision, and, reflecting on the sympathy that exists between the stomach and the eye, decided upon making trial of pulvis salinus compositus. In about eight months from the time of employing this remedy, all the lines and apparitions disappeared; and, remarkable to relate, quite suddenly "the laminæ of the crystalline body were brought into optical contact." Subsequently, thinking over the cataractous condition, and the process by which the crystalline is nourished and supplied with fluid, Sir David came to the conclusion that the cataractous disease was due to excess of albumen; that too little water and too much albumen were present in the aqueous which filled the chamber;" upon this hypothesis he argued that incipient cataract can be cured in two ways:—

1st. By discharging a portion of the aqueous, in the hope that when re-secreted it might contain a less proportion of albumen, and so tend to counteract the desiccation of the lens.

Or 2nd. By injecting distilled water into the anterior chamber after evacuation, to supply the quantity discharged, and thus change its specific gravity.

The first proposition is both practical and safe. A disease termed conical cornea has often been treated by tapping, when the aqueous is speedily re-secreted; distilled water has likewise been injected into the anterior chamber, without doing serious injury. Sir David's first experiments were made upon dead eyes; immersing these into water, he observed that the water quickly passed through the elastic laminæ, and in the course of a short time the capsule became ruptured and

broken up. Such a phenomenon must seem to have a bearing of importance in reference to the cause and cure of at least two kinds of cataract. The aqueous, he argued, "being in immediate contact with the capsule of the crystalline, when the humour contains too little water, the lens has an insufficient supply of the fluid which keeps its fibres and laminæ in optical contact; hence the laminæ separate, and the lens is liable to became opaque and hard. When, on the contrary, the aqueous contains too much water, the capsule permits the excess to pass into the lens substance, and produces the affection termed cataract."

To cure the first indicated form of cataract, we should then discharge a portion of the aqueous, and either supply its place by injecting distilled water, or leave it to nature to supply a secretion made more healthy by the administration of certain remedies; or we may supply the place of the discharged humour with a solution of a different density, containing albumen; or, by appropriate remedies, induce nature to secrete a more albuminous nutritive fluid.

Of the second, or surgical part of the proposition, that of evacuating the aqueous humour by repeated paracentesis oculi, this had already been admitted into eye practice. Dr. C. Sperino, of Turin, some time ago, fully tested paracentesis, and published the results of fifty-five cases successfully treated by the operation. Sperino's method was also tried by Dr. C. Raymond in a variety of diseases—cataract, irido-choroiditis, and other inflammatory conditions, with, he says, "a large amount of success." A very careful perusal of Sperino's writings convinced me that his proposal of repeated paracentesis had not been fully understood in this country; since it differed materially from paracentesis as ordinarily practised.

Upwards of half a century ago, paracentesis oculi was recommended and practised by Wardrop in certain inflammatory conditions of the eye. He particularizes cloudiness in the aqueous as a symptom demanding speedy relief by early evacuation of the humours, for the purpose of "diminishing irritation and lessening pain and tension of the organ." Dr. Sperino first tried paracentesis pure and simple for the same purpose. He certainly did not employ it on purely physiological grounds, but rather as an auxiliary to other remedies, and during the inflammatory stage of glaucoma, irido-choroiditis, hypopion, iritis, keratitis, and penetrating ulcer of the cornea. It was in these several forms of disease I practised section of the ciliary muscle at the Royal Westminster Ophthalmic Hospital, in the year 1859, and with an amount of success beyond my expectation. For many years prior to this date, I performed paracentesis in conical cornea, successively repeating the operation from twenty to thirty times. In some cases, the anterior chamber was tapped every second day—that is, three or four times a week—for a couple of months, but, so far as my experience goes, without sensibly diminishing the conicity. Both Beer and Rosa employed paracentesis in cases of hydrophthalmia, with very decided benefit. Beer thought it advisable to make the paracentesis through the same opening in the cornea on each occasion, and for this reason he employed a pointed probe after the first operation. Pittard tried paracentesis in a disease formerly known as *aquo-capsulitis*. He devised an instrument especially for the operation, a double-bladed knife, one blade sliding over the other, the edge of the under blade was not a cutting one, and acted as a grooved director, thus securing the gradual withdrawal of the fluid.

Mackenzie approved of paracentesis, and looked upon it in particular cases as an invaluable remedy, but "rather too nice an operation to come into general use." He employed a broad iris knife, and made his puncture the tenth of an inch from the juncture of the cornea with the sclerotic upon any point of the circumference, preference being given to the more dependent part. After the knife was made to penetrate the chamber, he directed it to be partly withdrawn, and slightly rotated on its axis, to allow of a gradual escape of the aqueous.

Desmarres employed a thin conical-shaped knife; after the first operation, he inserted a probe through the same opening, repeating the evacuation two or three times during the day. Dr. Sperino's practice, although bolder, resembled that of Desmarres; he employed for the paracentesis a small knife with a double-cutting edge, slightly curved on the flat, the concavity being turned upwards after it has been made to penetrate the cornea. The aqueous being allowed to gradually drain off, in subsequent repetitions he inserted a probe through the opening. The junction of the cornea and sclerotic is preferred for the operation, which is repeated as soon as the aqueous shall have become secreted. I prefer a stop-needle for making the paracentesis (represented in *fig.* 26), and this, on entering the cornea, should be held nearly parallel to the pillars of the iris, otherwise this membrane may be injured. After each operation, the eye should be covered for a time with a soft pad and bandage, and kept quiet until all pain has subsided. In most cases the pain of the operation will have passed away in a few minutes.

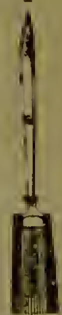


Fig. 26. Paracentesis Knife.

When paracentesis is practised for the relief of other disease than that of cataract, glaucoma, &c., it is of the

utmost importance that a diminution of the tension—intra-ocular pressure—should be the absolute result attained, nothing short of which can be serviceable to the patient. It is found useful to keep the pupil in a semi-state of dilatation, since it renders the eye more tolerant of subsequent evacuations. The capacity of the eye to bear a repetition of the paracentesis may be fairly guaged by the amount of relief obtained. Special forms of incipient cataract may be expected to derive benefit from the operation; and if, as Sperino says, the formation of cataract depends entirely upon a disordered state of the circulation, on a previous inflammatory condition, then free paracentesis must assist therapeutics.

The repetition of the punctures, and the intervals between each, must depend upon the renewal of the aqueous. It may be the work of an hour or two, or of days. With Sperino, I am persuaded that an opaque lens may recover transparency, provided its histological elements have not been seriously impaired, and therefore the amount of disorganization in the crystalline body marks the limit and extent to the number of tappings required to cure the disease; and from the first evacuation, a check seems to be given to its further progress; that is, if the cataractous condition is uncomplicated with choroidal or retinal disease.

Whatever the ultimate verdict of the profession on operative measures in the treatment of the incipient stage of cataractous disease, time and experience alone will determine; but of the propriety of resorting to medical treatment in all cases there can scarcely be two opinions. I have fully satisfied myself in numberless instances of the great value of therapeutic agents, in bringing about an altered condition of the specific gravity of the fluids of the eye, and thereby delaying or arresting further degeneration of the lens fibres.

MODES OF OPERATING FOR CATARACT:

THE SEMI-LUNAR SECTION; LINEAR SECTION; MODIFIED LINEAR SECTION; DIVISION AND SOLUTION; DISPLACEMENT AND DEPRESSION.

EXTRACTION OF CATARACT BY SEMI-LUNAR SECTION OF THE CORNEA.

The extraction of the lens is certainly at all times a *dernier résort* in the treatment of cataractous disease. To ensure success in an operation of so much importance, and which for minuteness and delicacy is unlike that of any other surgical operation, the operator requires considerable manual dexterity, and a perfect familiarity with the several complications of the disease, and the many hindrances to success. If the patient has been afflicted with serious functional disease, and the general tone has become lowered, the influence of such a state may prove unfavourable; and, therefore, in most cases of lenticular opacity the question is, not whether an operation is likely to cure or benefit the patient, but rather is there nothing about the general health likely to frustrate the success of an operation, no local disease in another organ likely by sympathy to affect the eye and bring on inflammation (*Mackenzie*). A careful and attentive examination must previously be made of the general health of the patient, and then of the condition

of the eye to be operated upon. The tension of the globe, the action of light on the pupil, whether the cataract has gradually or suddenly appeared, is complicated, associated with diabetes or glaucoma, whether the cataract is ripe, and has therefore arrived at the stage of maturity for extraction, and so forth. A faint perception of light, as of something passing between light coming from a window and the eye, is not a perfectly trustworthy diagnostic sign of the general soundness of the nervous textures of a patient's eye. Should there have been observed any recent change in health, or marked constitutional defect, then any operation will be performed at a risk of losing sight from subsequent troubles. Persons who suffer from periodical cough, chronic bronchitis, or other debilitating forms of disease, will be less likely to do well than very old people with a fairly good constitution. An aged gentleman of eighty, upon whom I operated, made a rapid and perfect recovery in ten days. The weather and barometrical pressure should be taken into consideration; for we must ascertain that the patient is in every respect placed in circumstances most favourable to ensure, as far as possible, a good recovery. The day before the operation an aperient should be administered; if an anæsthetic is to be employed, a full meal should not be taken for at least three or four hours before the operation. A due amount of attention having been given to what may appear to some as only minor points, it but remains for the surgeon to decide upon the safest method of extraction to be employed in each individual case; at the same time he will be prepared to meet accidents which may occur in the course of its performance. Although the operation requires great delicacy of manipulation on the part of the surgeon, it should be understood that the eye of the patient is not nearly

so sensitive to the touch of the knife as is generally supposed. The prevailing opinion on this point has probably arisen from the pain felt on the admission of a small piece of dirt or a fly between the eyelids. By a wise provision of nature, the eyeball itself disregards small matters. This can be proved by raising the eyelid and applying a piece of dust to the surface of the eye, when no pain and scarcely a sensation will be felt; remove the piece of dirt, turn out the lid, and whilst it remains everted, place the piece of dirt upon it, no greater sensation will be induced than was felt when it was applied to the eyeball. The inference is, that both surfaces, when separated, are not nearly so sensible to ordinary foreign bodies as is supposed. The two surfaces must be brought into direct contact, and the foreign body grasped by the lids, before a painful sensation will occur. If this were not the case, an irreparable injury would often be done to the transparent part of the eye before it excited attention. The experiment may be tried in a very simple and conclusive manner by merely keeping the lids apart by an effort of the will, when the end of the finger may be placed boldly on the eyeball without inconvenience. Irritation, or inflammation, by enlarging the vessels, gives rise to pain, the sensation is as if some extraneous matter were interposed between the lids.

Operations on the eye were formerly divided into many distinct stages. Wenzel published fixed rules for conducting the operation of extraction; it is, however, quite unnecessary to do more than choose the kind of operation best suited to the case, and in some instances to modify it according to the particular conditions of the health; further rules are of little value or assistance. The several methods commonly practised for the removal of cataracts are:—1st, Complete extraction by section

of the cornea—the flap operation, or linear incision, in cases of hard or fully-formed cataract; 2nd, division, decision, or solution—the needle operation, comminuting the capsule and lens, and leaving the fragments to dissolve in the aqueous, adapted for soft cataract and that of childhood; and 3rd, depression or reclination—displacement of the cataract, depressing it below the axis of vision, now only very occasionally practised upon people whose constitutions do not admit of "modified linear extraction," and in cases of secondary complications of cataract. The instruments employed in flap extraction are the spring speculum (*figs.* 27 and 31) for fixing and separating the lids; the forceps (*fig.* 34) for

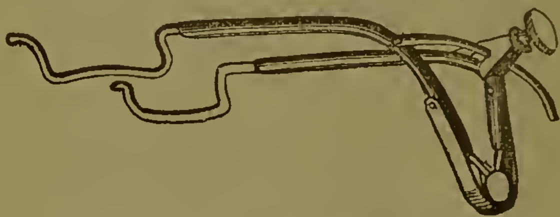


Fig. 27. Spring speculum.

seizing and steadying the eyeball; the knife (*figs.* 28, 29, and 30) for making the section; the cystitome, or bent needle (*fig.* 32), for rupturing the capsule; and Daviel's curette, seen near the wire spoon (*fig.* 33), for making pressure on the eyeball, and assisting in the delivery of the lens.

The size and form of knife used in making the section in the operation for cataract is a matter of more importance than may at first sight appear. During my early acquaintance with eye surgery, and for many years before I became surgeon of the Royal Westminster Ophthalmic Hospital, the knife employed by preference

over that of any other was the triangular knife, known as "Beer's knife," Mr. Guthrie regarded it as the perfection of a knife; for my own part, and perhaps from long handling of small delicately balanced knives in microscopical dissections, I looked upon it as too broad and too large, especially towards the base, and the angle it subtends as decidedly too great. A few

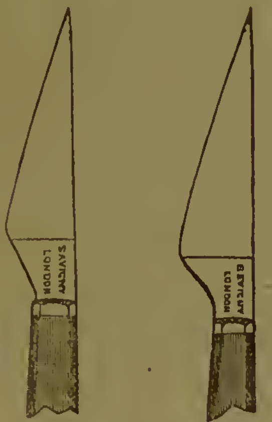


Fig. 28. Beer's knives.

Fig. 29. Wenzel's knife.

years ago, in a paper read before the Medical Society of London, I exhibited my modified narrow-bladed cataract-knife to the Society—the knife may be described as something between a small Wenzel and a narrow-bladed Graefe; at the same time I pointed out what I considered the defects of the latter, namely, its extreme thinness, and its liability to bend if made to traverse a cornea somewhat degenerated, one undergoing arthritic change, arcus senilis. I noticed, also, that if Von Graefe's thin knife entered the cornea too obliquely, the point may pass through the lamellæ some distance

without entering the anterior chamber, and thus miss making a counter-puncture exactly at the spot we wish

Fig. 30. Modified cataract knife.

it to be made. The success of the operation is thus occasionally marred, for the corneal section will be altogether too small to admit of the delivery of the lens. This, however, is an accident which should not often occur; but for these and other reasons, I designed the form of knife, a *modified* Graefe (represented in *fig.* 30), the blade of which is stouter than a Graefe's, and in shape more of a Wenzel's, but not nearly so broad in the blade.

My speculum differs somewhat from that ordinarily used. I often found the patients, by the action of the

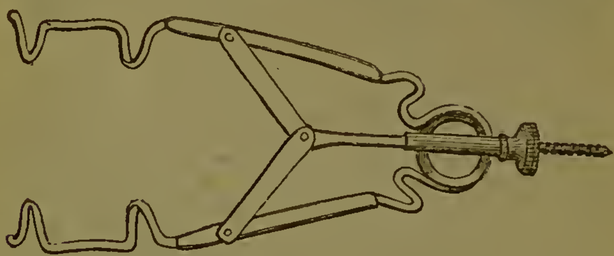


Fig. 31. Improved spring speculum.

muscles able to close their eyelids during the operation; in order to obviate this I had a screw collar arranged to act upon a jointed cross-bar (*fig.* 31), and which affords an amount of resistance of considerable

value in eye operations. To ensure perfect fixation of the globe the forceps must be toothed. The cystitome, or curved needle, for tearing the capsule, is bent at right angles to the handle.


Fig. 32. The cystitome.

The earliest known method practised for the extraction of cataract maintains its place in our *Ars Chirurgicus.* Daviel, a French surgeon, in 1785, was the first to perform extraction through an opening in the cornea, In his excellent essay on "A New Method of Treating Cataract by Extraction," he says he "caught the idea from Petit, who in 1708 opened the cornea to extract an opaque lens which had re-ascended after depression, and fallen into the anterior chamber; so that he felt himself urged to devise some new mode of operating by want of success which he found to attend couching, and from its destructive effects on the internal textures of the eye, as observed upon dissecting the eyes of those who had been operated upon in that way."


Fig. 33. Spoon or scoop for delivery of lens.

Remarkable enough, Daviel commenced his extraction operation by passing a small lancet-shaped knife into the anterior chamber, close to the inner margin of the cornea. He then

Fig. 34. Forceps for seizing and steadying the eye-ball.

enlarged the incision by means of another instrument similar in form, sharp on both edges, and blunt at the point, and lastly completed the semi-circular section with the bent probe-pointed scissors. The inconveniences arising from the employment of three kinds of instruments were remedied by Palucci, La Faye, Sharp, and others, all of whom employed a simple form of knife; this was made to enter at the temporal side of the cornea, and pass through the anterior chamber, making its exit at the opposite or nasal side, thus completing a crescentic-like incision.

The several steps of the operation of extraction are, section of the cornea by the knife, the rupture or division of the capsule, and the delivery of the lens. The patient is first placed in an easy recumbent position before a good light, a north light is usually preferred. The position chosen is of importance, as a slight change from the usual mode of operating may lead to an untoward result The surgeon should operate with the hand he is commonly in the habit of employing, for unless he is ambidexter, he had better not attempt to acquire an unnecessary dexterity simply to avoid a change of position. When operating on the right eye, he should stand behind the patient, and before him when operating on the left. The patient's head being gently and comfortably supported by a pillow. The surgeon leaning forward, brings the first two fingers of the left hand over the forehead quietly down on the eyelid, and raising it up slowly and smoothly, fixes it firmly against the upper edge of the orbit; and there it must be retained with the end of the forefinger, so that the patient cannot lower it or close the eyelid by any effort of his will. The surgeon should be able to do this, and at the same time make pressure on the eyeball, in order to fix it at any moment of commencing

the incision. So soon as the index finger is in this position, the second finger leaves the upper, and is brought down to steady the globe on the inner or nasal side. When an assistant is at hand, the lower lid is drawn down and fixed, as represented in *fig.* 35. The eye is thus completely exposed, and this must be done gently and tenderly, without giving pain or uneasiness to the patient. Since the introduction of anæsthetics, the spring-speculum, *fig.* 31, has superseded the use of the fingers for separating the lids; nevertheless, when the patient elects to submit to be operated upon without chloroform, the skilled operator will prefer to use his fingers.

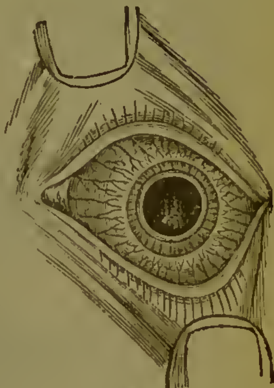


Fig. 35. Mode of separating the lids with the fingers.

The left eye must be fixed in a similar manner; the surgeon, standing before the patient, raises the upper lid with the side of the forefinger of the left hand, and depresses the under lid with the thumb, the hand resting on the nose. The pressure of the forefinger is made to fix the eye, and at the same time render it immovable. The incision of the cornea should be made upwards, and any deviation must be regarded as an exception to the rule, as in the case of a patient with a very projecting orbit, or a sunken eye-ball.

To proceed with the operation: the patient having been encouraged to remain perfectly quiet, with the eye turned downwards, the operator places the middle finger of the left hand on the inner part of the globe, and, well poising the knife between the fingers and thumb of the right hand, enters the point at the temporal side, about a line or a line and a half from the juncture of the

cornea and sclerotic, and pushing it on through the anterior chamber, the counter-puncture being made rapidly, and the section completed with great care and precision, as shown in *fig.* 36, after which an instant of

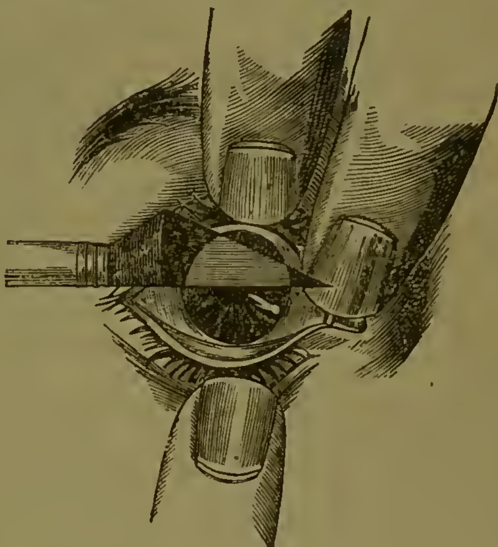


Fig. 36. A flap operation on the right eye with Beer's knife.

repose is permitted, and the upper eyelid allowed to fall, whilst the blood accumulated about the lids is gently sponged away. The eyelid must once more be raised, and the rupture of the capsule proceeded with. The bent needle or cystitome is then cautiously passed in between the lips of the wound, and moved from right to left. The patient is now directed to turn his eye downwards, and gentle pressure is made with the curette or spoon upon the eye-ball; the lens then smoothly glides into the anterior chamber, and makes its way out through the opening in the cornea. Should it, however, be arrested in its course, by gently kneading

the eye-ball with the curette, the extraction will be accomplished, after which the lids should be closed, and once more sponged. In a few minutes we proceed to ascertain whether there are any fragments of the capsule left behind in the pupil, and if so, they must be cautiously removed, either with the curved hook or the curette. Lastly, the eye should be dried with a soft cambric pocket-handkerchief, and padded with a pledget of cotton wool, and firmly bandaged.

A drop of a solution of atropine should be instilled into the eye a day or two before operating; this I look upon as a precautionary measure, serving a double purpose, that of determining the condition of the lens, and if a synechia be present, and of avoiding the risk of operating on an immature cataract, which would certainly leave behind in the pupil fragments of capsule or lens, and produce a secondary cataract. Perfect stability of the eye is an important element in making a perfect section of the cornea; on this account, forceps will always be preferred to fingers. Without fixation, the eye of an unsteady patient will follow the knife and roll inwards. To guard against this accident, a fold of conjunctiva must be seized a little above or below the junction of the cornea and opposite the point of entrance of the knife, care being taken not to lacerate the membrane. The forceps represented in the wood-cut, *fig.* 34, are furnished with fine, but not cutting teeth, by means of which they take a firm hold of the conjunctiva. Upper section of the cornea is in every way to be preferred to lower section, although more difficult of execution, a difficulty counterbalanced by its greater advantages. Should the knife be made to penetrate the cornea too obliquely, the point will traverse the lamellæ for some distance without at all entering the anterior chamber, and it will be better to

withdraw it and re-enter it, or make an opening from above downwards with Jaëger's broad-shouldered triangular knife. Such an accident may be avoided if the knife be fairly poised between the finger and thumb, and the point entered perpendicularly to the cornea, and at the distance of a line from the sclerotic coat. The point having penetrated the anterior chamber, is known by its brighter appearance as distinguishable from the dull look of that portion of the instrument remaining within the denser part of the cornea, and by the absence of resistance; the handle must be directed slightly towards the temple, so as to make the knife divide the cornea parallel to its edge. It is a matter of considerable importance that the section be purely corneal, not sclerotic, and a good corneal margin left of sufficient breadth to secure corneal union.

A great impediment to a successful termination is a section made too small to admit of an easy delivery of the lens. The easy extraction of a cataractous lens, like that of a stone in the bladder, depends much upon a clean cut and a fair-sized opening; a difficult and forcible removal is almost certain to end disastrously. The enlargement of the section after the escape of the aqueous, places the iris in danger, and lasceration of the hyaloid risks the loss of the vitreous. Should the lens sink down behind the iris, by waiting a few minutes it will reappear, and may then be removed with the spoon, *fig.* 33. Any attempt to excise the iris after the lens has escaped, will be followed by hæmorrhage into the interior chamber, causing protracted healing, and secondary cataract. When all goes well, it is simply necessary to separate the eyelids for the purpose of ascertaining if the pupil is perfectly clear, care being taken not to use pressure, which is likely to rupture the hyaloid, now bulging forward, and very easily torn.

By way of obtaining a more perfect adaptation of the edges of the cornea, with a very soft piece of sponge, make a few circular movements over the closed eyelid, and lastly apply a pad of wool and a bandage. At one time it was thought expedient to close the lids with a narrow band of black sticking plaster; this certainly secures the eye from the meddlesome interference of nurse and patient. The patient should be kept in bed from four to six days, and at the end of this time, if no inflammatory symptom appears, the bandage may be partially removed, and he may be allowed to move about the room.

After long experience, and with great opportunities for comparing results, I am decidedly of opinion that the flap operation, properly performed, is a far better one than any other, since it involves no actual mutilation of the eye. In the majority of cases good vision is obtained by the patient, and when assisted by well-adapted cataract glasses, is everything that can be desired, no deformity of the eye being present. What the late Mr. Travers wrote of semilunar section, some half century and more ago, is in perfect accord with my experience of to-day, that "This operation is by far the most perfect ever devised for the cure of cataract, but it is one of considerable difficulty, and the several modifications which have been at various times suggested owe their origin to the disappointments and defects which operators meet with in learning to execute it with skill enough to ensure success."

Of my last fifty flap operations, not more than five (ten per cent.) were failures. In the case of Mrs. E. H., the operation promised perfect success, everything went on smoothly and quite well until the third day, when the patient accidentally struck her eye rather violently; this gave her very considerable pain. Belladonna and

warm fomentations were applied. The next morning the lids were swollen, and on making a careful examination, the corneal flap was discovered turned down. Inflammation followed, together with sloughing of the cornea. In the second case a nervous restless patient uncovered the eye, and attempted to use it on the second day after the operation; inflammation and separation of the flap occurred, and the eye was ultimately lost. In the third case failure arose from an extremely fluid vitreous, the greater part of which escaped during the operation, causing collapse of the eyeball; on the third day after the operation erysipelatous chemosis of the lids and deep-seated inflammation supervened, and sight was lost.

It by no means follows that a considerable loss of vitreous during the operation will be attended by such results as those just narrated, as was seen in the case of Maria C., admitted into hospital November 16. She was very nervous about the operation, and wished to have chloroform; it was not until after a considerable quantity of the anæsthetic had been inhaled that she became unconscious, and quiet enough to admit of the operation. After section of the cornea, and as the capsule was being lacerated, she gave a plunge, and out came the lens, followed by a considerable quantity of vitreous humour, and a portion of the iris. As the iris could not be returned, it was snipped off. On the following day the patient complained of much pain, this was relieved by the administration of full doses of opium. On the fourth day the intolerance of light was most distressing. In a few days this subsided, and on an examination being made, it was seen that the pupil was quite clear. At the end of six weeks, with a convex glass of two and a half inches focus, she could read large-sized print.

It is unnecessary to give the particulars of each case, for nearly all ran a tolerably good course, terminating in good or fair sight. Secondary cataracts occurred in eleven cases, and were removed by subsequent operations. Case 32 ended in secondary cataract; Mrs. E. W., aged 60, with double cataracts; nervous temperament; eyes full and prominent. The left, being a fully-formed cataract, was selected for operation. The patient was rather unsteady, and my assistant had a difficulty in supporting the upper lid. In so doing, he made considerable pressure upon the eyeball just as the knife was cutting its way out, and in consequence it came out suddenly, about an eighth of an inch from the junction of the sclerotic. The lens was extracted with difficulty, probably leaving behind portions of capsule. At the end of three weeks the secondary cataract was removed, and the patient obtained fair vision.

A feature of some interest in these cases, one which especially deserves notice, is the successful extraction, in three instances, of traumatic cataracts, with recovery of sight. Penetrating wounds and blows received on the eyeball, very frequently lead to lenticular opacity; such injuries produce iritis, a torn retina, or destructive inflammation of the eyeball. If an accident of the kind produces lenticular opacity, we must resort to early extraction—the displaced lens is a foreign body, and may set up irreparable mischief if not removed. The following cases bear upon this question:—

Wm. S., aged 68, received a violent blow on the right eye, which was followed by a traumatic cataract. With a Beer's knife, a small corneal section was made. As the lens did not show a disposition to start, an adhesion was suspected, and the extraction was finished with the scoop. The patient had no bad symptom, and, in fourteen days after the operation, was able to read large type with a No. 2 convex glass.

Sophia P., aged 38, received a blow from a fist on the left eye, producing traumatic cataract, September 3rd. The lens was extracted through a small corneal opening. On the 11th the eye was opened; everything in the meantime having gone on well, she was able to count fingers, the pupil being perfectly circular. September 18th (fifteen days after the operation), the patient was able to read No. 4 Jaëger's test-types with a two and a half inch convex glass.

Repeated attacks of inflammation after the receipt of injury are very liable to produce destruction of the eyeball; nevertheless, occasionally a case will do well even when repeated inflammatory attacks have appeared to destroy vision. A gentleman, A. C., aged 82, some years before I was consulted, received a slight injury to the left eye, this was followed by rheumatic iritis and lenticular opacity. At intervals, inflammatory attacks occurred, and gave great trouble, and notwithstanding the remedies employed, suppuration within the capsule took place. I recommended early extraction of the lens, as a relief to his sufferings. As there was some difficulty in turning the eyeball downwards, lower section of the cornea was made; a dense white nucleus of a lens, in a drop of milky-looking fluid, was extracted, and complete relief followed. Although a slow recovery was made, it was not a little surprising to find that the patient could discern large objects. In two months from the operation, he read with a deep convex glass large test-types.

If a comparison could be made between the operation described, and of "modified linear" extraction preceeded by an iridectomy, I believe a preference would be shown for semilunar section of the cornea, which secures for the patient, a circular movable pupil—a matter of moment, as a limited power of accommodation for viewing distant objects is preserved.

With regard to the anæsthetic employed in eye operations, I prefer Robbins' Bichloride of Methylene; experience in its administration assures me of the advantages of this agent over chloroform, it is safer, and produces quieter sleep, with less excitement, less frequent vomiting, and a quicker recovery. I am not at all disposed to acknowledge the superiority of Æther, for in my twenty-seven years experience of hospital work, I never lost a patient by the administration of an anæsthetic.

LINEAR EXTRACTION OF CATARACT.

The operation of linear extraction of cataract was most certainly originated by the late Mr. Gibson, of Manchester, who always resorted to it for the treatment of soft cataract. In the first instance, he freely ruptured the capsule of the lens with a needle, and at the end of two or three weeks proceeded to allow the flocculent masses to flow out through a small linear opening, made on the temporal side at the sclero-corneal junction with a Beer's knife. A curette introduced through the opening, allowed the whole of the nuclear portions of cataract to flow out. In this way the pupil was cleared, and all danger of iritis avoided. Mr. Gibson concluded that, by linear extraction, the repeated employment of the needle might be superseded, and the eye exposed to less danger and risk of after inflammation. He took special credit to himself, because in performing this operation "the iris had never been injured, or even irritated in the slightest degree."

Mr. Travers and other surgeons had recourse to extraction of hard cataracts by a similar method, through a section less than a semicircle of the cornea, but it was

left for Graefe and his pupils to boldly cut away a large portion of the iris, in all cases of extraction; and he insisted that his method was not only safer in strumous subjects, in whom the flap operation would be attended with considerable risk. He subsequently slightly varied his operation; and in the "modified linear," it is thought, we have an operation applicable to all kinds of cataract in the adult, whilst it permits of an earlier examination and use of the eye, and is attended with less inconvenience both to the patient and surgeon. Encouraged by these statements, Graefe practised a similar operation, and his "modified linear extraction" may now be said to be the operation of the day.

The instruments usually employed in the performance of the operation, are the spring speculum, the forceps for fixing the globe, Graefe's narrow-bladed knife, cystitome, bent iris forceps, and scissors for abscising the iris. The scoop has been added by Schuft.

Modified linear extraction is divided into four parts: 1st, the small or linear section of the cornea, with the narrow-bladed knife, *fig.* 37, or Jaëger's bent knife, *fig.* 46, made in the upper segment of the cornea and sclerotic. 2nd, the seizure of a small portion of the iris by the forceps, figs. 38, 39, or 40, its abscission by the iridectomy scissors, fig. 38. 3rd, the free division of the capsule with the bent needle, or cystitome, *fig.* 32, and 4th, the delivery of the lens with the curette, or traction instrument, *fig.* 33, or the spoon, *fig.* 42.


Fig 37. Graefe's narrow-bladed knife.

The preliminary iridectomy is a *sine quà non* of the operation. Very soon after iridectomy became fairly established in the practice of eye surgery, it was engrafted upon all operations for cataract, as it was said

the percentage of failures would thereby be considerably lessened. But it can scarcely be said to be an entirely novel eye operation, as it was certainly originated by Cheselden, and somewhat similar methods were

Fig. 38.

Fig. 39.

Fig. 40.

Figs. 35, 36, 37. The several forms of Iris Forceps.

subsequently practised by Henermann, Guerin, Jarvin, and the elder Wenzel, in 1786. The latter, indeed, introduced a somewhat improved method of value, that of cutting out a small portion of iris, through an opening previously made in the cornea for closed pupil, which for all time superseded the plan of inserting the needle through the sclerotic coat, and cutting behind the pillars of the iris.

Just before Wenzel published his treatise on iridectomy, Reichenback, in 1767, devised a kind of cannula-

cutting forceps, for the purpose of making a central opening in a closed pupil; and it appears that Wenzel's innovation upon an operation which in Cheselden's

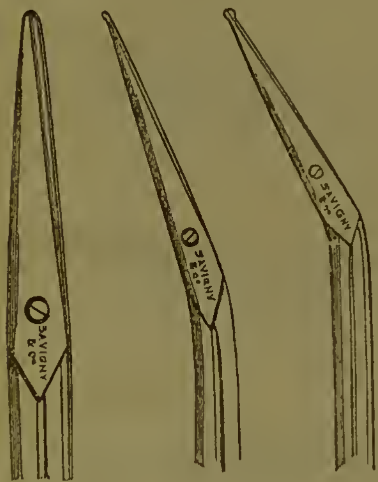


Fig. 41. Iris scissors.

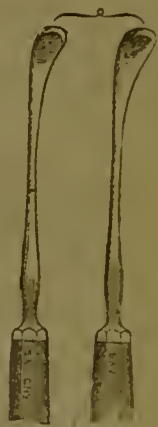


Fig. 42. Schuff's Scoop or spoon.

day proved unsuccessful, partook of the nature of an accident. He was operating for cataract when the iris became entangled in the edge of his knife, and on withdrawing it, a comparatively large portion of the iris was abscised. The eye did very well, and the vision of the patient was certainly improved by the larger pupil thus accidently made. It appeared to him, therefore, that cutting out a small piece of iris at the moment of extraction, might be done advantageously, a result he endeavoured to secure in subsequent operations; this proceeding ultimately proved a failure, and the practice was abandoned. Twenty years later, a son

of Wenzel revived the operation, and wrote a treatise on the value of abcising the iris; subsequently Beer introduced a modification of the operation, which was generally approved, and threw the former method for a time into the shade. This then became the operation *par excellence*, iridectomy. French ophthalmologists seized upon Von Beer's idea, and both Sichel and Desmarres practised it in cases of synechia and secondary cataract, boldly cutting out a large portion of the iris, and with considerable success. The results

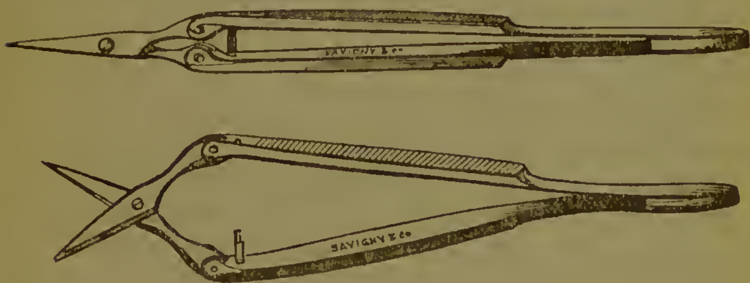


Fig. 43. Noyes' spring-handled iris scissors, for abscising the iris with the left hand.

were not always quite so satisfactory, and in some instances the neoplastic products served to undo the good obtained by the iridectomy, and once more the operation seemed doomed to pass into oblivion. Von Graefe recognised its value, and fully believing it could be turned to account in the treatment of traumatic cataract, adhesion of the pupil, prolapse of the iris, closed pupil from iridocyclitis, &c., he subsequently wrote—"I have substituted a simple iridectomy for the older operation, and which consists in cutting through the cornea with a double-edged lance-shaped knife, carrying it through the several tissues as far as

the vitreous body, and then withdrawing it immediately; for experience has shown me that plastic exudations possessing sufficient elasticity will retract on being cut through, and leave an opening large enough for useful vision." He deprecated further interference, from a dread of lighting up fresh inflammatory action in the iris, and surrounding tissues. His "simple iridectomy" may be described as subcutaneous abscission of the iris, and he boasts of having reduced the dangers of forming an artificial pupil to a minimum, by employing a small knife, with which he was enabled to divide adhesions both before and behind the pupil (*De Wecker*).

The remarkable success which in the hands of Professor Graefe attended "modified linear extraction" of cataract excited the attention of ophthalmic surgeons throughout the world. Nevertheless, the mutilation of the iris, the frequent hæmorrhages which followed its abscission, its ultimate effects upon vision, the production of astigmatism and other derangements which ordinary glasses failed to correct, led, in the first instance, to much controversy, and ultimately ended in the adoption of so many modifications, that, as was jocosely remarked by Warloment, after visiting the Ophthalmic Hospitals of London, "If I ask what method of operating is employed, I receive for an answer, 'We operate by the method of Von Graefe, but we modify the operation to suit the case, and it is evident enough that the old classical method is not yet abandoned, for even Bowman adopts the most absolute selecticism, and I saw him, *horresco referens*, perform several extractions by the old flap operation, and without any previous iridectomy.'"

It will be seen, as Warloment justly remarks, that the opinions and practice of ophthalmic surgeons, with regard to the operative treatment of cataract, are still

in an unsettled state; and although Von Graefe's linear extraction is largely adopted, it is modified to suit the exigencies of the case. The question to be determined before operating in all cases, is as to size, form, and situation of the section, and as to whether an iridectomy should be performed. Every operator will decide for himself as to the easiest and safest method to be employed, so as to do the least amount of violence to the eye, leave the parts in the most favourable condition for repair, to avoid the more serious dangers, and to obtain the best optical results (*Critchett*). The curvilinear section, representing the segment of a circle, is said to be the best, and this should be about double the size of the circumference of the cornea; it should also be confined to the opaque white tissue, constituting the border-land between the cornea and sclerotic, trusting as far as possible to this, and making it of such a form as to permit of the free exit of the lens. There are, however, risks in this operation:—1st, Great liability to escape of vitreous humour; 2nd, proneness to secondary iritis; and 3rd, *possibility* of sympathetic ophthalmia. The reason of the first of these incidents is usually some spasm and pressure at the moment of the exit of the lens, or a long formation of the cataract in the eye, involving toughness and opacity of the capsule, atrophy of the ciliary ligament, and a fluid state of the vitreous humour. Secondary iritis usually depends upon some bruising of its tissue at the moment of exit, or of fragments remaining in the pupillary area, or a constitutional proneness to fibrous inflammation after wounds, aggravated by entanglement of the cut angle of the iris in the wound. Sympathetic ophthalmia (fortunately of rare occurrence) is probably due to encroachment of the section upon the ciliary nerves, and a bruising of that sensitive tissue during the transit

of the hard cataract. These contingencies may, however, be avoided—the chief source of danger being not so much of the seat of the wound as *the point of puncture and counter-puncture*; these being very liable without care to encroach upon the ciliary region. In order to lessen the danger, a greater curve should be given to the wound, so as to make it represent a larger segment of rather a smaller circle, in such a manner that the puncture, the counter-puncture, and the remainder of the wound, are in the opaque tissue close to the cornea, and at a safe distance from the ciliary ligament, exactly in the situation where iridectomy is performed. It may be argued that in this way we are departing too much from the curvilinear and returning to the semicircular form of section, but although this may be in a measure true, it is unimportant when combined with iridectomy. In a majority of cases this method of operating, if carefully carried out in all its details, will give excellent results, and possibly has advantages over a simple corneal operation. Under the most favourable circumstances, however, the warmest advocates of the method must admit, as an inevitable result, the permanent mutilation of the eye by the loss of a portion of the iris, the frequent obstruction to light produced by opaque capsule, and irregular astigmatism.

M. Warlomont has described a modified section of the cornea, which avoids certain valid objections to the mutilation of the iris. The section made is curvilinear and entirely confined to the corneal tissue, and may be performed without chloroform. It is nearly painless, is seldom attended with prolapse of the iris or synechia, leaves the eye with a good circular pupil and in almost perfect optical conditions; is, in short, my own small corneal section, performed for many years with the narrow-bladed knife of Graefe. Mr. Critchett

seems to think its adoption is indicated—1st, when the modified linear extraction has failed in one eye; 2nd, whenever both eyes are operated upon at the same time, one should be treated by this method; 3rd, when the patient is unable or unwilling to take chloroform; 4th, in persons but little past middle age, in whom the cosmetic result is important, and where it is desirable to obtain the highest optical result; 5th, when the cataract is not quite mature, and likely to be sticky, or to leave fragments behind; in cases where distance renders a secondary operation for the division of capsule difficult or even impossible; 7th, when the anterior chamber is small and the circumferance of the iris is close to the cornea so as to preclude a satisfactory curvilinear section through the opaque tissue between cornea and sclerotic. The objections and sources of danger are simply those of the ordinary flap operation.

In this operation healing is more rapid, and if the section is carefully made, only a slight scar, after the lapse of a month or two, remains visible. A further modification of Graefe's operation was proposed at the Ophthalmological Congress, by Dr. Bribosia, and which it appears he practises with success. He first ruptures the capsule by introducing, rather obliquely through the cornea, about three millimetres from the sclero-corneal margin, and a little below the transverse diameter, one of Bowman's fine stop needles, with which he ruptures the capsule of the lens. This is done dexterously and rapidly, to avoid any escape of the aqueous humour. Section within the sclerotic margin is made with a slender knife, and an iridectomy simultaneously performed. A sufficiently large portion of iris will be removed, thus avoiding its after-withdrawal and abscission, as in Graefe's method. The lens is

subsequently pressed out in the ordinary way. The advantages of this method are stated to be as follows:—1. Facility and rapidity of execution, the eye being thoroughly fixed by the operator himself. 2. The opening of the capsule is performed with more exactness and neatness. 3. Less frequent escape of the vitreous. 4. Adaptability to persons of a nervous temperament, and those whose eyes are much sunken in the sockets. Previous evacuation of the aqueous does appear to be a very great objection, but it is very difficult as a rule to make a section of the iris whilst cutting through the sclerotic coat.

The sacrifice of a small portion of the iris in the complications of cataract appears to be quite justifiable, but a large abscission, as proposed by Pagenstecher, is contrary to the conservative tendencies of modern surgery, and must be productive of optical derangements due to the dazzling effects of a large coloboma, and by increased circles of dispersion and astigmatism.*

---

* Many more people suffer from astigmatism than is supposed, and iridectomy must be charged with a large share of blame in this matter. To test astigmatism in patients it is necessary to present before their eyes an equal number of lines ruled vertically (at equal distances and of equal thickness), and the same number ruled horizontally, and side by side on the same sheet of paper. After the lines have been intently looked at for a few seconds, and the apparently more distinct ones fixed upon, the sheet should be turned 90°. The vertical lines then become horizontal, and it is a check against any inaccuracy in ruling, if with the changed position the same result is noticed with regard to the horizontal. To test the kind of glasses required to correct astigmatism, the patient should be tried with a series of lines, radiating from a point at a fixed angular distance. These should be looked at with a series of lenses of different convexity, until one is reached which restores at a fixed distance the image lost to the unassisted eye.

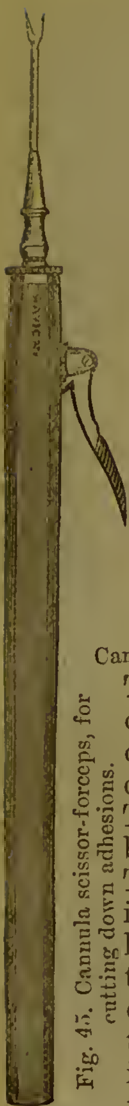


Fig. 45. Cannula scissor-forceps, for cutting down adhesions.

Fig. 44.
Cannula forceps.

I am of opinion that the iridectomy should be small. The several steps of the modified linear extraction, such as I am in the habit of performing, may be very briefly described. The lids being separated by the spring speculum, a firm hold is taken of the conjunctiva by the toothed forceps held in the left hand, and opposite to the point at which the knife is about to be entered. With the narrow-bladed knife, poised between the first two fingers and thumb, the cornea is penetrated about one millimetre from its junction with the sclerotic, and pushed on rapidly through the anterior chamber to cut its way out of a corresponding point on the opposite side of the cornea. The small bent iris forceps with the blades closed are then cautiously introduced, a piece of iris seized and withdrawn, and cut off close to the cornea with the spring scissors. The iris must not be seized with the points, but with the convex part of the forceps. The cannula forceps (*fig.* 44) are preferred in some instances, as they retain a firmer hold of the membrane. Should a slight portion of iris protrude between the lips of the cornea, it must be gently pressed back into the anterior chamber with Davel's spoon; if bleeding occur, the blood must be removed by the curette, and a drop of atropine

instilled into the eye. Lastly, the operation being completed, a pad of cotton wool and a bandage is carefully adjusted, and the patient put to bed. Some surgeons prefer to make the cut in the sclerotic coat about one millimetre from the border of the cornea, and if it is intended to stop at a preliminary iridectomy then it should be about the fifth of an inch in breadth; the cut may be effected with more precision by using a Jaëger's lanced-shaped knife (*figs.* 46, 47, and 48), either straight, or bent on the flat at an angle of 140 degrees to the shaft. If thought desirable, the incision can be still further enlarged with a probe-pointed knife. When posterior synechiæ are formed, these should be cut down by means of the cannula scissors (*fig.* 45).

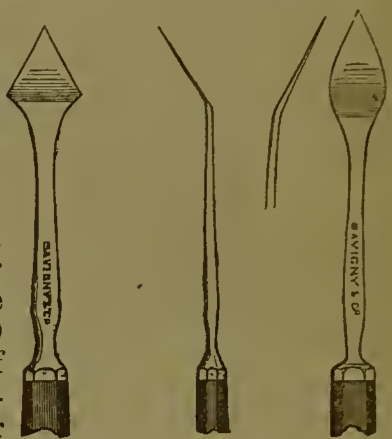


Fig. 46. Straight iridectomy knife. Fig. 47. Profile view of bent knife. Fig. 48. Knife, with edges rounded off.

If the patient is doing well, the eye may be opened about the fourth day. The pad and bandages should be renewed daily, and if moisture is noticed about the lids, it should be carefully removed by bathing the eye with warm water. The eye should be at first cautiously exposed to light, and the bandage not quite thrown aside until the section has soundly healed.

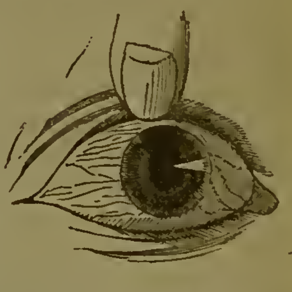


Fig. 45. The lid raised to show an upper iridectomy in the right eye.

In the practice of Dr. Little, of Manchester, the removal of senile cataract by the "modified linear extraction" has been followed by satisfactory results. In 200 operations on 148 patients, 78 of whom were men and 70 were women,—their ages ranging from thirty-two up to eighty-one years,—one hundred and fifteen of the eyes belonged to patients who were sixty years of age and upwards, and it is interesting to observe what effect age has upon the result of extraction. Eighteen were attacked with iritis (nine of which ended in a closed pupil); two were lost from panophthalmitis, two from irido-choroiditis, and one from sloughing of the cornea. Fifty-six of the patients were noted as being marastic, delicate, rheumatic, or as being in bad health. Of these, ten were followed by iritis, and five terminated in a closed pupil, and five were lost. The state of health was some criterion as regards the prognosis in most of the cases.

Eye complications.—As regards the nature of the cataracts, six were noted as posterior polar cataract, thirteen lenses were retrogressive, and three were of a glutinous consistence. Three cases were complicated with myopia, one of them amounting to one-seventh, and all were successful. Four eyes presented posterior synechia, two iridodonesis, two were glaucomatous, one was accompanied with enlargement of the lachrymal sac, two had chronic conjunctivitis, and three were marked as having obscure posterior disease.

Operation, and accidents during operation.—In making the incision with Graefe's knife, Dr. Little endeavoured, with a few exceptions, to lay the centre of the section just within the cornea, thereby diminishing the risk of rupturing the hyaloid membrane. He made an attempt also to ascertain beforehand the size of the nucleus in each case, and to limit the length of the incision.

In eight cases the incision had to be enlarged with blunt-pointed scissors before the expulsion of the lens could be effected. Loss of vitreous occurred in twenty-two of the extractions (in nine cases before the exit of the lens); eight of these twenty-two cases were followed by iritis, making one-third of the whole number. The spoon was used to remove the cataract on twenty occasions (twice without any loss of vitreous). Collapse of the cornea or eyeball occurred twenty times after the extraction; vitreous was lost in four cases; iritis took place four times, and one case terminated in irido-choroiditis.

Healing process.—Amongst the inflammatory consequences of this method of extraction, iritis was found to be the most frequent. It happened twenty-seven times in the 200 operations, nine of which ended in closed pupils, the remaining eighteen recovered useful vision. Ten ultimately read No. 1 Jaëger, three No. 2, two No. 4, one No. 14, one No. 16, and one No. 19. In three instances the pupil was so much contracted upwards that a secondary operation was afterwards performed. Atropine was instilled into the eye from six to eight hours after the operation, continuing its use two or three times daily for several days, and in many instances early dilatation of the pupil warded off an attack of iritis. Seven out of the nine cases of closed pupil promised useful vision after some further operative interference; the iris in each case appeared healthy, there was a good anterior chamber, the pupil was, however, partly occluded by false membranes, but there was good perception of light. The other two cases, although there was excellent perception of light, were not so favourable for a second operation, in consequence of some exudations behind the iris, causing a bulging here and there on its anterior surface. Of the 200

extractions there was a total loss of seven cases; two from sloughing of the cornea, two terminated in panophthalmitis, and three in irido-choroiditis. There can be no doubt that the loss of vitreous, and introduction of the scoop into the eye to remove the lens, is productive of inflammatory troubles, arising from bruising the iris and cornea, and also from the impossibility in very many instances of clearing the pupil of portions of lens substance. Rather more than one-third of the cases of iritis which occurred were attended with loss of vitreous, in seven cases small hæmorrhages followed between the second and ninth day after the operation, and which could in no way be accounted for. Dr. Little's cases show the adaptability of "modified linear extraction" to senile cataract. He quite agrees with me that the section should be corneal.

In tabulating results and in testing the vision of patients, it would be useful to employ common terms of comparison; as—1. *Complete success*, when the patient is capable of reading the smallest print, No. 1 Jaëger, with appropriate glasses. 2. *Moderate success*, when the patient can read large characters and make his way about easily. 3. *Imperfect success*, when the patient can only count fingers at the distance of a foot. 4. *Failure*, when only quantitive perception of light, or an insufficient amount to enable the patient to go about alone; and this it would be well to adopt generally (*Graefe*).

REMOVAL OF CATARACT BY DIVISION AND SOLUTION.

The removal of cataract by division and solution is an operation of considerable value. It was at one time

almost exclusively confined to the removal of soft and congenital cataracts, but it has obtained wide-spread popularity since Dr. Jacob, of Dublin, first practised keratonyxis—that is, breaking up the cataract with a needle or needles, passed in through the cornea. This method proved to be a better and safer operation than that of discission—introducing a needle through the sclerotic, and cutting up the cataract. An extensive experience induced Dr. Jacob to apply his operation to almost all forms of cataract, and he summed up the results of a large number of cases in the following emphatic words:—"I have no wish to indulge in any exaggeration respecting the success of this method. I am writing for surgeons who will, in the sequel, pronounce a verdict upon it from their own experience, and thereby verify or disprove my statements. . . I refrain from performing the ordinary operation, extraction, because it is in its nature a most formidable operation, and in its results a most hazardous one. In principle, too, it is not creditable to surgery. To cut open a man's eye in order to squeeze out his crystalline lens through the incision, when that lens can be removed by absorption, I hold it to be contrary to the rule which binds the surgeon to give his patient the best chance of recovery, regardless of present inconvenience or delay. But whatever view may be entertained on this subject, I am firmly convinced that the operation of extraction should be restricted to hard cataracts in aged persons. Under fifty years of age, the crystalline lens once broken in pieces must be sooner or later dissolved and absorbed. There can be no question as to the result; it is only a question of time."

Dr. Jacob employed very fine curved needles in his operations, occasionally, I believe, much finer than those now employed, and represented in *figs.* 50, 51, 52, and

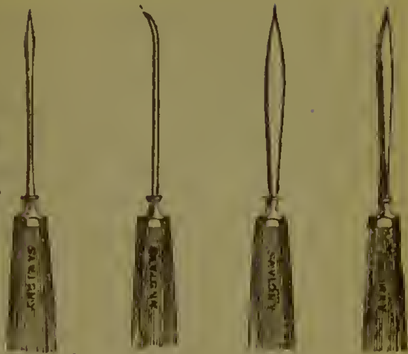


Fig. 50. Fig. 51. Fine needles for Keratonyxis.

Fig. 52. Fig. 53. Broad cutting needles.

53. Jacob's needle operation is very largely employed in the removal of cataract in young persons, and up to middle life; the length of time occupied in the process of cure varies very much. Making a linear incision through the cornea near its sclerotic border, and allowing the fragments of the broken-up lens to escape, by inserting a narrow grooved director, or curette, is another mode of operation. Before either a needle operation or linear incision is performed, the pupil should be previously dilated with atropine. The minute puncture made by a needle in the cornea heals readily, leaves no mark behind, and is rarely followed by inflammation. If, however, the cataract should prove to be of somewhat firmer consistence, the sudden admission of the aqueous occasions the lens to swell up, and it may then produce a serious iritis. To prevent a mishap of the kind, Sperino and Graefe recommended previous simple puncture of the capsule, which after the expiration of some days is repeated, until complete solution is effected. If fragments of capsule persistently remain undissolved, and obstruct vision, these should either be cut down, depressed, or extracted through an opening in the cornea with the cannula forceps. In young persons and in subjects favourable for the operation, very soon after the needle ruptures the capsule and the lens is broken up, fragments of it rise into the anterior chamber and absorption begins.

The patient should be placed in the recumbent position, whilst the operator stands either before or behind him, and enters the point of a double-edged needle a little above the horizontal median of the eye, about a sixth of an inch from the margin of the cornea, passing it in behind the iris. The rupture of the capsule is in this way accomplished, and by slightly rotating and depressing the needle the lens is quickly broken up. To prevent the needle penetrating too deeply, and doing injury to the choroid, Mr. Bowman designed a stop-needle—that is, a needle with a shoulder about four-tenths of an inch from the point. With this kind of needle it is almost impossible to penetrate deep enough to wound the retina. A strong solution of atropine should be instilled into the eye two or three times a day for the first week, and the eye kept covered with pad and bandage. Should iritis supervene from fragments of the lens pressing on the iris, active treatment must be resorted to or vision will be in danger of being lost.

DISPLACEMENT AND DEPRESSION, OR RECLINATION OF CATARACT.

Displacement, the removal of the cataractous lens out of the field of vision, by an operation termed couching. There are two methods of performing displacement, that by depression and that by reclination; whichever method is adopted, it is simply assigning a new situation to the cataract, at the expense of the vitreous humour, which is no mere gelatinous mass, but an organised structure intimately associated with the refractive media of the eye, and consequently of the highest importance to vision. To lacerate the hyaloid membrane, as will be done in tearing away

and forcing down the lens into the vitreous, is certainly to court a very serious injury of the internal textures of the eye, excite inflammation of the ciliary body and iris, or disorganize some other structure, and lead to insensibility of the retina. If destructive effects do not quickly follow the operation, the lens will remain entangled in the vitreous as a permanent cause of irritation and inflammation (*Mackenzie*). Neither depression nor reclination is often resorted to; the risk of injury to the eye is very great, and the removal of the cataract out of the eye is far less dangerous and much to be preferred.

In depression, the cataractous lens is taken down by one of the needles represented in *figs.* 50, 51, 52, and 53, to such a depth below the level of the pupil, into the vitreous, that it shall no longer present an obstacle to vision; whilst in reclination, the needle is applied to the upper edge and anterior surface of the lens, which is then pressed backwards, and downwards into the vitreous between the interval formed by the external and inferior straight muscles, and there left impacted in the vitreous, with its anterior surface directed upward, and its superior edge backwards. In either operation the needle should be inserted through the sclerotic coat; the better form of needle is *fig.* 51. A bandage should be applied, and rest enforced in the horizontal position for two or three days. Should iritis be imminent, a solution of atropine must be instilled into the eye, or belladonna applied over the brow, and small doses of grey-powder administered two or three times a day.

SECONDARY CATARACT.

It not unfrequently happens that small fragments of lenticular substance of a very transparent nature

escape observation during the operation of extracting, these afterwards float up into the pupil, and there form, in the course of a few days, an opaque obstacle to vision. This is termed a "a secondary cataract," and consists almost exclusively of portions of lenticular substance. A similar result may follow iritis or other inflammatory action, and at the end of a week a pseudo-membraneous exudation will often produce closure of pupil. Bleeding after abscission of the iris, and lymph remaining unabsorbed, will also form extensive pupilary adhesions. After the operation of division or solution, it is difficult enough in a delicate patient, to prevent the formation of a secondary cataract, If the membrane consists of a thin opaque portion of capsule, it may be left to the solvent power of the aqueous humour. Its solution will be facilitated by the administration of iodide of potassium; if there is no congestion of the vessels of the conjunctiva, and no great amount of lachrymation, the action of the drug will be assisted by instilling into the eye a weak solution of atropine once or twice a day. In the other cases mentioned, it may be necessary, after waiting for the inflammatory action to subside, to make an effort to remove the cataract by a needle operation. Mr. Bowman proposed to clear the pupil of capsular secondary cataract, by tearing the opaque membrane through with two small needles, employed simultaneously. He introduces them near the opposite edges of the cornea, passing them down to the membrane, and their points being made to impinge close on each other, are separated, at the same time tearing or cutting the membrane across, and carrying the fragments in opposite directions. By this method of operating no drag is made upon the vascular parts of the eye. If, however, the membrane is very dense, and closes the pupil, a small opening must be

made in the cornea, and an artificial pupil formed, as in iridectomy, detached and comminuted portions being extracted by the cannula forceps. To Sir W. Wilde, of Dublin, we owe the adaptation of the ingenious cannula scissors, represented in *fig.* 44. With these scissors passed into the eye through an opening made in the cornea, adhesions and false membranes can be cut down, whilst the cannula forceps seize the separated portions, and withdraw them. One blade of the forceps being single-toothed, is received between the two teeth in the other blade, thus forming obtuse, and not cutting points; by touching a small spring, the blades close up and pass into the eye smoothly, by relaxing this they fly open, and can be made to seize the membrane. If closure of pupil should have taken place without severe and long continued inflammation of the iris, simple incision with the cannula forceps will be sufficient; it was in cases of the kind that Cheselden first operated with so much éclat. If the texture of the iris has been seriously damaged by long continued inflammation, then it will be better to freely abscise the iris; but here we must expect to be placed at some disadvantage by the situation of the artificial pupil.

Beer adopted the method of making an artificial pupil through the cornea, and with a rather large double-edged knife cutting into the anterior chamber and through the closed pupil at one stroke. Janin and Maunoir employed scissors, and obtained a like result, with less risk of tearing the iris from the choroid, whilst other operators preferred and practice incision of the iris with a small narrow-bladed knife, entered through the sclerotic coat. This method of operating was also adopted by Cheselden in cases of closed pupil. If the iris is adherent or much thickened, it will not be attended with success, for the fibres of the iris will no

longer contract, the small opening will speedily be closed up, and the artificial pupil destroyed.

It may appear to those unaccustomed to operations on the eye that couching or displacement of the lens is a very simple method of restoring sight, and might reasonably be expected to succeed. It is thought that a needle entered through the sclerotic coat, and made to press the opaque body out of sight, is all that is necessary. Nevertheless, vision may be utterly destroyed in attempting this operation. By entering the needle at a wrong place or giving it a wrong direction, or even holding it in an improper position, the ciliary processes may be injured, and internal bleeding of a serious nature take place; or vision may be irrecoverably extinguished by pressing down a hard lens into contact with or even through the delicate nervous tissue, the retina. It is evident, therefore, that even the most simple-looking operation performed on the eye requires to be carefully studied and fully understood. The minuteness of the organ and the delicacy of eye operations naturally tend towards converting the ophthalmic surgeon into a specialist. A multitude of facts in this department of surgery and medicine must be fully mastered, and nothing done slovenly, nothing carelessly, nothing at random.

SPURIOUS AND MIXED CATARACT; SECONDARY CATARACT FROM CONCUSSION.

A cataract arising from an effusion of coagulable lymph in consequence of an iritis, before or after an operation, is either a spurious or mixed secondary cataract. The false membrane may be very slight and only partially impede the action of the pupil, or it may

be combined with opaque portions of capsule and lens, and occupy the whole of the pupillary space. In slight cases, and where the opaque membrane merely fringes a portion of the pupil, it is advisable to cut down with a needle, and afterwards freely dilating the pupil by instilling a four-grain solution of atropine two or three times a day. In the mixed variety of secondary cataract the needle operation effects but little good, the more effectual remedy is a free iridectomy and the frequent application of atropine. It is in these mixed cases that abscission of the iris is of the utmost value and importance; experience has shown us that the plastic membrane, if simply cut down, will quickly re-unite, and the condition of the iris be made worse than it was before, for no permanent artificial pupil will be formed.

The extraction of false membrane was accomplished by Gibson through an opening in the cornea with either the simple hook or a pair of double-hooked forceps. Cannula scissors are now, however, employed for cutting down and at the same time withdrawing a portion of the membrane. But if the secondary cataract does not quickly shrink up, an attempt should be made to seize it with the cannula forceps and extract it through an opening in the cornea. There is yet another form of secondary cataract of somewhat common occurrence, and which has not been noticed: that produced by concussion of the eye-ball, or by a blow received, not directly on the eye, but in the neighbouring part, or at a distant part of the body, as in a railway collision. I have placed on record several cases of the kind, one or two of which are referred to in my little book "On Impairment or Loss of Vision from Spinal Concussion or Shock."

Many writers make mention of the total loss of

vision after injury to the spine and general shock to the nervous system, others allude to the formation of cataract from organic changes brought about by impaired nutrition. A wound or a blow near the eye of a very slight nature may end in opacity of the dioptric media. A bathman received a slight wound near the left eye from a fragment of porcelain, and in three weeks afterwards the sight of the eye on the same side began to fail, and in six weeks the lens became opaque. An officer at the siege of Badajos received a wound over the eyebrow by a small piece of shell; pain and inflammation followed, and vision became gradually lost. The pupil was fully dilated and immovable, and the crystalline lens opaque (*Wardrop*). Loss of sight has immediately followed similar injuries. A sailor was struck by a ramrod on the eyebrow, and although the eye itself sustained no injury, he at once became blind, and the lens was soon after seen to be opaque. A bar-woman, whilst opening a bottle of soda-water, received a blow from the cork on the left eyebrow, and in a few days afterwards the lens was observed to be milky. A patient of Dr. D'Eyber became affected with cataract in consequence of a wound received on the eyebrow by a stone, but which did no harm to the eye itself. Loss of vision with and without cataract will often gradually follow the receipt of an injury. I have seen cataract developed three or four months after the receipt of a blow on the malar prominence and eyebrow, received in a railway collision by a woman of middle age and otherwise healthy, without any injury having been sustained directly by the eye itself.

The distribution of the first branch of the fifth pair, or ophthalmic branch, explains how wounds or injuries of the frontal, infra-orbital, and other branches of nerves which form anastomoses with the ophthalmic ganglion,

are sometimes followed by blindness; and the facts related show the great sympathy which exists between parts whose nerves have a direct communication with each other (*Wardrop*).

THE CHOICE OF CATARACT GLASSES.

The loss of the lens necessarily leads to diminished refraction and loss of accommodation, and this in all cases will require to be compensated for by the use of double convex, plano-convex, or menisci glasses of different foci. In about a month or two after a successful operation the patient will feel that he needs spectacles, and if these are carefully adjusted, vision will be almost as acute as it was before the operation. In choosing glasses the object will not be obtained unless sight be perfectly distinct, but their too hasty selection may bring the eyes to a state of weakness, which will unfit them for those employments which require good sight. Cataract glasses should not be furnished until the eyes have habituated themselves to the absence of the lens; having selected proper glasses, they should be worn for an hour or two at a time, and then the first pair selected will serve their purpose for several years. The nearer the object to be viewed the more convex the glasses must be, but if chosen of too long a focus, that is, five inches instead of four, and three instead of two-and-a-half, the patient will not see well with such glasses unless he moves them an inch or two forward from his eyes. On the other hand, if glasses of too short a focus have been chosen, they will bring the object too near, so that a mistake as to distance will be made, and in attempting to grasp a thing the hand will generally fall short of the object. The extreme

of hypermetropia usually follows extraction of the crystalline lens, and we have what is termed "aphakeal eyes." To secure perfect vision for all distances a number of glasses of different foci will actually be required, but as this is practically out of the question the patient usually contents himself with two pairs of glasses; one for reading and seeing near objects, and the other for viewing things at a distance. The strongest for near should be of about + or 2 + $2\frac{3}{4}$, and for distance + 3 or + $4\frac{1}{2}$, or even more. Of course glasses of the longer focus appear to answer the purpose best and are therefore preferred; the meniscus form allows of a greater range of vision. Small oval glasses are usually chosen, and if the patient is not particular about the appearance of the spectacles, the outer portion may be blackened out with advantage.

A. S. MALLETT, PRINTER, 68—70, WARDOUR STREET, LONDON, W.

For vision

Choose good Glasses,

Evenly polished, perfect in

figure, and free from specks.

Adjust their power by the Optometer for each eye separately, and take care that they be not too deep.

Be sure also that the centre of the glass is exactly centered in the spectacle frame.

Elderly people, who use focal shorteners or convex glasses, should never look through their spectacles at distant objects, but only over them

Never wipe your spectacles with anything but the softest wash-leather, which you should always have at hand for that purpose.

Spectacles should never be worn by anyone without having accurately ascertained the nature of the defect for which they are sought, as in some instances they would do more harm than good.

Persons who have unequal refraction require very peculiar forms of lenses, as the ordinary kinds are not adapted for that purpose.

If the spectacles are scratched, cracked, or damaged, or if the frames become twisted, they should be changed for new ones; and far-sighted persons require the power to be increased every year or two.

A person having selected a pair of spectacles ought to be able to read this entire page: otherwise there is some defect in vision besides that which arises from an abnormal condition of the refracting humours.

This is the smallest type that is made, but is seldom used as it would try the eyes.